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Protecting People and Homes From Wildfire in the Interior West:

Proceedings of the Symposium and Workshop

Intermountain Research Station
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Protecting People and Homes From Wildfire in the Interior West:

Proceedings of the Symposium and Workshop

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National Fire Protection Association

PREFACE

Objectives of the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West were to:

1. Examine the problems of protecting wildland homes from fire
2. Reveal the threat of wildfire damage to life and property and the high cost to every taxpayer through increased taxes and insurance rates
3. Present state-of-the-art approaches to the home-wildfire problem
4. Develop recommendations for homeowners, government agencies, fire assistance personnel, and the business community to help solve the home-wildfire problems in the Interior West

During the 1970's, Federal land management agencies in the Interior West expanded their concept of wildfire control to encompass "fire management." Under this new policy they continued to suppress unwanted fires, but also adopted a more active role in preventing damaging wildfires through management of fuels, including the use of prescribed fires and other measures to reduce fuel buildup. "Fire management" resulted from the following realizations; (1) fire is a natural process, which for thousands of years has reduced fuels and regenerated forest, shrubland, and grassland vegetation; (2) human ability to suppress damaging fires remains quite limited; (3) human attempts to exclude fire often resulted in more damaging fires than would otherwise have occurred under a natural fire regime; and (4) on the other hand, people can manipulate the fuels (living and dead vegetation) so as to minimize damage from an unwanted fire.

At the same time that these concepts of fire management were becoming accepted in National Forests, National Parks, and some other public lands, on private lands the potential for economic losses and deaths was growing rapidly, corresponding with an increase in the number of homes being built in hazardous wildland fuels. In 1984, for example, four dozen homes were lost in a single fire in central Montana, and the potential for much greater losses throughout the Interior West continued to increase.

It was with these concerns that we met in 1985 with Steve Laursen, then State Extension Forester in Montana (currently Natural Resources Program Leader with the Minnesota Extension Service), to organize a symposium and workshop to address all aspects of the problem. Soon, this steering committee was expanded to include Gerry Baertsch of the University of Montana's Office of Continuing Education, and we began planning the symposium for a date 2 years hence. In the spring of 1986 we asked Dan Bailey, a fire management officer on the Lolo National Forest, to chair the symposium and workshop, a task that he handled with skill and enthusiasm. The USDA Forest Service, University of Montana, and Extension Forestry were soon joined as symposium sponsors by the Society of American Foresters, National Fire Protection Association, and the Montana Department of State Lands.

While our symposium plans were in full swing, the Washington, D.C., office of the Forest Service began a national initiative on the same topic and organized meetings of more limited scope and attendance than the ones we planned. Shortly before our symposium was held, the National Fire Protection Association, in cooperation with the Forest Service and the U.S. Fire Administration, published a splendid background document called "Wildfire Strikes Home," which resulted from their conference held in Denver, CO.

Ironically, the spectacular 1987 wildfire season in the West threatened the attendance and thus the success of our symposium; but large numbers of people were able to break away from fire duty in northern California, Oregon, and elsewhere just in time, and attendance swelled to over 500. As we had hoped, this event brought together diverse groups responsible for or concerned with the protection of people and homes from wildfire in the Interior West. These included city and rural fire departments, State and Federal fire control and management personnel, State service foresters, extension agents, soil conservationists, consultant foresters, and professional tree services, land-use planners, land developers, home builders, homeowner associations, county and State officials, realtors, mortgage lenders, insurance industry professionals, and still others.

These proceedings are a compilation of symposium presentations. In some cases they are transcriptions from tape recordings, which the presenters were subsequently allowed to inspect and edit. Because of the diverse audience, the presentations are non-technical and are often conversational in style. The authors are solely responsible for content and style of their presentations.

Several dozen people contributed directly to the symposium's success through service on the program committee, as session moderators, speakers, panelists, workshop leaders and coordinators, and poster presenters. Assembling the proceedings after this complex event was a daunting task accomplished by two project secretaries, Jan Bixler and Charlene Houska.

Symposium attendees will note that the threat of wildfire to people and homes continues to grow. Several buildings were lost in a February 1988 wildfire near Whitehall, MT; 15 homes were lost outside Rapid City, SD, in July 1988; and last-minute fuel reduction measures were applied to save multimillion dollar facilities at Old Faithful and Grant Village in Yellowstone National Park. Sadly, many more homes will have been lost to wildfire by the time this proceedings reaches your hands. Nevertheless, implementation of the concepts, procedures, and practices contained herein, can minimize the losses of not only homes, farm buildings, and commercial structures, but also the loss of human lives.

William C. Fischer,
Stephen F. Arno,
Compilers

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FIRE MANAGEMENT IN THE WILDLAND/URBAN INTERFACE - A CHALLENGE FOR RESEARCH AND MANAGEMENT

William T. Sommers

Forestry managers and researchers alike are being challenged by changes that are accompanying the social and demographic adjustments that the United States and many other parts of the world are experiencing as we move into post-industrial societies. Many of us enjoy the benefits of those changes and live in or near a wonderful place where we can experience the beauty of nature while enjoying the creature comforts of urban living. Those of us not fortunate enough to live in this place, probably will visit or vacation in it soon. This place is the Wildland Urban Interface.

In our modern perspective, wildlands are thought to be something for our pleasure with all danger and discomfort removed. By frequenting them, we seek to escape from the negative aspects of urban life while requiring that the full scale of positive urban living benefits be provided to us. One does not have to step back too far to realize that an inherent and self-deluding conflict is present. Since much of the wildland area of the United States is composed of public lands, Federal, State, and Local government agencies are at the focal point of this conflict. Moreover, emergency services, including fire protection, are usually the most stressed element in the wildland urban linkage. We are being challenged with new realities and new requirements that will only increase in importance in the years ahead. They are challenges we can not ignore. Some thoughts about these challenges and what we need to do to meet them follow.

Although fire in the wildland/urban interface is receiving increased attention at the local, state, and national level, there is little information on the magnitude or significance of the problem. Available information is fragmented, incomplete, and difficult to aggregate on a national scale. Further, data are inadequate to project trends or analyze cause and effect relationships. Without such data and analyses, fire managers, the public, legislators, developers, and others involved with fire in the wildand/urban interface are unable to assess the situation, make informed decisions, or plan for the future at local, state, and national levels. Therefore, we need to define, describe and quantify the wildland/urban interface from a fire management perspective. We need to determine the spatial and temporal distribution and trends of fire-related attributes of the wildland/urban interface.

Perhaps the most critical knowledge deficiencies with wildland/urban interface fire problems are those involving the behavioral sciences. Fire managers lack the fundamental knowledge about interface residents necessary for sound program planning. Furthermore, managers need to know how to work effectively with local governing bodies in implementing fire safety and risk-reduction programs. Finally, incentives that affect the behavior of all actors in the interface must be understood before effective program planning and implementation can occur.

Analyses of the fire environment (fuels, weather, fire behavior) resulting in fire risk and hazard within the wildland/urban interface need to be made. We lack knowledge on changes in the natural fuel complex resulting from anthropogenic stresses. We lack knowledge on the physics and expected behavior of fires within the wildland/urban environment.

There is a lack of information concerning community and structural design procedures to reduce the fire threat to the wildland/urban interface. We need models for evaluating fire risks for community designs and plans. We lack methods of evaluating fire risks for individual structures and sites. We need improved fire-resistant construction materials and systems.

Wildfire and prescribed fire in the wildland/urban interface have potential to cause residual impacts on the urban environment, either by causing changes in ecosystem properties that affect future fire hazard/intensity or by creating direct, offsite impacts such as air pollution/smoke or sedimentation. We need to better understand responses of vegetation to fuel hazard reduction techniques that might be used in the wildland/urban interface. Effects of such treatments on the structure and composition of recovering vegetation may significantly alter fire hazard and risk in these areas. And, we need to better understand the effects of fire on soil erosion, sedimentation, water quality, and flooding which can cause substantial property damage, environmental impacts -- and even loss of life -- in developed areas of the wildland/urban interface.

Mr. Sommers was invited to prepare this paper as a foreword to these proceedings.

William T. Sommers is Director, Forest Fire and Atmospheric Sciences Research, U.S. Department of Agriculture, Forest Service, Washington, DC.

Assessment of fire hazard in the wildland/urban interface is necessary to assist landowners, fire managers, and regulating organizations in efforts to minimize losses of life and property due to wildfire. The topic of fire hazard is considered here to emphasize elements of flammability and difficulty of suppression of structures, vegetation, and other fuels in the urban/wildland interface, and does not include risk of ignition or values of urban improvements.

We lack reliable criteria to develop effective fuel and vegetation management guides to protect homes from wildfire damage in wildland/urban interface areas. Existing hazard reduction guides for forest areas are mostly based on rather subjective assessments of hazard. The reliability of such guides over the full range of conditions that exist in forest residential areas is not sufficiently known.

What are the most cost effective strategies and tactics for wildland/urban interface fires? The effectiveness (including limits) of most suppression activities -- in terms of fire behavior, fuels, and application variables -- have not been quantified in terms necessary to allow the tradeoffs of different suppression alternatives to be determined and an optimization process applied.

There are no well-defined methods for evaluating the costs and benefits of hazard modification on (a) homesites, (b) neighborhoods, or (c) adjacent flammable vegetation. Each of these levels of resolution present different opportunities for reducing losses in wildland/urban fires and have different decision maker needs. Informed allocation of financial resources by any of these groups of decision makers is very difficult without a well-displayed integration of estimated costs and predicted losses.

SESSION 1--KEYNOTE

Laurence E. Lassen, Moderator
Director, Intermountain Research Station
Forest Service, U.S. Department of Agriculture
Ogden, Utah

THE CHALLENGE OF PROTECTING PEOPLE AND HOMES FROM WILDFIRE IN THE INTERIOR WEST

Honorable Norman Bangerter
Governor of Utah

Thank you very much and good morning. I'm glad to see that firefighters get up and go to work in the morning like everybody ought to. It is a pleasure to be here in Missoula and in the state of my good friend Ted Schwinden. I appreciate his invitation to be with you this morning along with yours. I've enjoyed Ted Schwinden for many, many years and he's a great fellow and I'm sorry to see that he has decided not to run again, but I can understand why. Some days the fires get hot even in the Governor's office.

In accepting this invitation I wondered what I could do as a Governor to contribute to this symposium. At first, I felt like I don't really have any experience fighting those fires, and what could I tell those of you who have for many, many years. What would I tell you that you don't already know. But as I thought more about it, I realized that maybe I have more in common with you than the eye would first see. After all, as Governor, it seems like half my time is spent putting out fires and the other half is trying to light a fire under some staff member or department head, legislator or the public in order to accomplish the challenges that we have. As Governor, you are always aware of the risk of things getting too hot to handle or of getting burned.

There is another reason why it is appropriate for me to be here. I was in a scheduling meeting last Friday afternoon when I was interrupted by a phone call from Wasatch County, which is about 40 miles to the east of Salt Lake City. It happens to be the place where I have a summer home. The call was from the owner and developer of that property. He asked if I could arrange for a tanker to protect my home. There was a fire burning not too far from there and he was getting a little nervous and thought that I might be able to use my influence. Needless to say, I was interested all at once, and sent my security people out to get more information, called the Forest Service and others in the area about what the challenges were and how threatened we were. I called one of my sons and said, "Are you in a position that if I call you, you could go to the mountain and at least get our mementos out of our home up there in case the fire gets too close?" Well, within a couple of hours they called back and said they felt they had the situation under control and to my knowledge, my summer home is still intact. I hope that that is the case. But it is something that we all think about as we go through the challenges of where we build, how we build, and what we build.

Most of my life, as indicated, has been spent in building and land development. And as a result, much of my life has been devoted to taking a piece of ground and turning it into a subdivision--a place where people can live and will reside. As the population of the West grows, there's a growing need for housing, for new subdivisions, and new communities. That is a fact of life. One natural consequence, however, is that people end up living in areas that were once either under agricultural use or, in your terms and mine, were wild country. Sometimes, there is a tendency for people to assume when they leave cities for the more rural or suburban settings, that they still have the same kind of fire protection. The fact is, however, a home built on the edge of a forest is going to face different fire risks than a home in the center of the city. And if yours is in a place like mine, it probably doesn't have the kind of fire protection and water system that we have in the cities in the volumes that could make the difference. So some of those systems are also weak as well.

The risk of wildfires, to not only wildlife but to human life and property, are apparent to all of you. A check of recent history demonstrates the damage that has occurred from fires. For instance, in 1985 wildland fires resulted in the loss of 1,400 homes, 3 million acres, and 44 lives--both civilians and firefighters. In 1986, 13,500 people were evacuated from areas threatened by wildfires, and 3 firefighters lost their lives. The 1987 wildland fire season isn't over yet, although hopefully the worst of it is over. Already, two fires in California have destroyed some 65 homes. Just one month ago, more than 500,000 acres of forest land had burned in California, Idaho, and Oregon. During a two-week period, more than 20,000 people were involved in

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Keynote Address presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Honorable Norman Bangerter is Governor of Utah and Chairman of the Western Governors Conference, Salt Lake City, UT.

fighting wildfires. Undoubtedly, some of you here today participated in those emergency actions.

Although Utah land was not involved in the worst of the September range fires, our rural community of Oak City has almost been burned over by wildfire three times in the last seven years. Several other communities in Utah, including Grantsville, Gosham, and Alberta have also been seriously threatened. Within the past few weeks, a grass fire in the foothills above a fashionable Salt Lake City neighborhood caused us some concern. Fortunately, it was brought under control before any homes were seriously threatened.

The risk to wildlife and the environment from wildfires is also very self-evident. The risk to human life and property is also very real.

What can we do about these risks? Appropriate action can be taken in three areas. And I might add that with the challenges that every government entity is facing, with budget crunches, and that's from the federal government to local governments where probably most of you are involved, we still have to make sure we keep our priorities straight in protecting the infrastructure that is so important to all of us. So the three things that I think we can do are:

1. Assess and evaluate the risks of fire. And this shouldn't be done after something is built. This should be done before something is approved and allowed to go forward.

2. We can increase education to enhance prevention. And that's something that's needed in every home in America. We've had, in Utah, not just for the areas that are at greater risk but for all of our citizens, an education program where we've tried to encourage every family to make an evacuation plan for their individual home. We had an instance in one of our small communities last year where a family gave credit to their son for having brought home that fire plan idea and, them having sat down and made one, for saving the lives of some of those children and saving many of their precious possessions.

3. We should emphasize training and coordination of firefighting efforts. And that's where all of you come in, in a very real way.

I'd like to take a moment to discuss each of these areas. First, we should attempt to better understand the physics of fire behavior. The development of systems to assess and manage fire hazards in areas once unpopulated, now residential, could help firefighters be more effective in fighting those blazes. The mixture of structures, vegetation, fuel properties, and moisture relationships are not always well understood. This is particularly true in areas only recently developed. The better you know what you're dealing with, obviously, the more successful you are going to be.

Second, better education can enhance fire prevention. Property owners, local governments, as well as recreational land users, need to have a better understanding up front of the threat of wildfires and how to minimize fire risks. In some instances, fire safety ordinances or building codes may be inadequate. And I emphasize that. As a developer, I was always challenging those and you will continue to be challenged by the developer because the tendency is that 'we want to build something and we don't want too much interference'. We have to make sure that that is balanced. Fire ordinances for an established urban area may not be adequate for a newly developed residential section, particularly on the edge of a forest or in a forest, as I happen to be. For instance, it may be prudent to prohibit the use of highly flammable roof materials in high fire hazard areas. We have a lot of propane tanks in the area that I'm in and of course, they can be very hazardous as well. It has been said that ignorance is bliss; in this case, it may be fatal. Part of the education process is for fire protection agencies to come up with rational solutions rather than unreasonable impediments. That's the balance that we talk about when we talk about developers and planners and regulators reaching that accommodation which is so necessary for the general safety of our people. A few dollars invested in prevention efforts may save lives, millions of dollars spent in fighting fires, and millions of dollars in property loss. And I might add, millions of dollars in insurance premiums.

The third area that we need to constantly address involves the training of firefighters and coordination of firefighting efforts. As more homes are built in these marginal areas, the complexity of firefighting continues to increase. As you know, these fires and structural fires are simply not the same. Methods designed to extinguish a residential fire are not effective against the power of a wildfire. As residential areas spread into formerly unpopulated wildlands, the need for training increases. I suspect that few wildland fire suppression personnel are adept at fighting structural fires. Nor are most municipal fire departments trained or equipped for wildfires. Specialized training may help assure adequate responses to wildfires on the fringe of residential development.

I mentioned earlier that during a two-week period last month more than 20,000 people were engaged in fighting western fires. This is part of a great cooperative effort among firefighting agencies across the nation. Utah committed much of our supervisory force and sent two trained crews of state prison inmates to the fires. At one point, our forestry division had personnel in Hawaii, Idaho, California, and Oregon. Fortunately, no significant fires occurred in Utah while our people were in other states. Agreements already in place among the western states, as well as a variety of agreements with the federal government, facilitate this kind of cooperation. The importance of cooperation with each other cannot be overemphasized.

Nationally, the Forest Service, National Fire Protection Association, United States Fire

Administration, and National Association of State Foresters have combined efforts to address the problems of wildfires in residential development. As a western governor, I want you to know that I support and appreciate those efforts. For our part, Utah will continue to cooperate with other states and contribute to controlling and preventing these fires. I'm confident that other western governors feel the same as I do--that we simply must work together in order to effectively deal with this threat. I commend each of you for your efforts individually and collectively as you deal with the challenges we face in protecting our public lands as well as our private property. And I, as with you, may have the same interest, that it's not only someone else's property, but it's sometimes our own.

Thank you very much for allowing me to be with you, and I hope you will have a very successful conference and come to some real conclusions as to what we can do to enhance our efforts in this area.

A NATIONAL CRISIS

Anthony R. O'Neill

ABSTRACT: The problem is clear: As more people throughout the nation move from urban areas to more rural settings they are exposing their homes and their families to highly combustible environments -- environments not equipped with urban or even suburban municipal infrastructures necessary to protect these newcomers. The result of this migration has been tragically clear: wildfires which heretofore posed a threat to wildlands alone, are now taking lives and property. Yet, with programs which lead to heightened public awareness and education, home owners, business and governmental leaders and the fire service can effectively meet this growing problem head on. Although a level of national attention is necessary, solutions must be achieved at the state and local level and their success will come through a multi-disciplinary approach.

INTRODUCTION

Senator Melcher, distinguished guests, members and colleagues; it seems only yesterday when one and a half years ago I had the pleasure of welcoming several of you to the National Fire Protection Association ... where we held a Task Force Meeting to identify strategies for getting involved in combatting the fire problem of the wildland/urban interface. Remember, this was in the wake of one of the most severe wildland fire seasons in the history of the nation.....1985, when 83,000 wildland fires burned 3 million acres, destroyed or damaged 1,400 dwellings and killed 44 civilians and fire fighters. Something had to be done!

At that meeting in April, our small group of 20 experts hit the ground running. We made tremendous progress brainstorming ways that we could harness the many talents available to us in the United States. Just a few months later, the next generation of over 100 leaders met in Denver.

I'm sure most of you have had a chance to see the fruits of those intense meetings -- The "Wildfire Strikes Home" report. In it, the strategies for seeking solutions to this problem are clear: a united effort -- not just on a national basis, but regional and local as well -- must be developed, drawing attention to the problem and implementing solutions. By the end of that conference in Denver, we knew the next step in this initiative would be to gather on a regional basis ... to bring together various multiple disciplines ... to plan and develop strategies, and programs that will work -- because each and everyone of us has a stake in seeing results.

And all of this because we are interested in preserving and protecting what we have -- our families, our homes, our landscape and our natural environment. As we go about the business of preserving and protecting what we have, we intuitively focus our efforts on three steps. First, we generally acknowledge that there's a problem and then we try to define it. Secondly, we agree on strategies to solve that problem. And third, we find a way to implement those strategies. This week, we're somewhere in between step 2 and step 3 -- at the leading edge of change, and we're 500 strong! How quickly the number of committed individuals and organizations has grown. And how encouraging that growth is to all of us at the National Fire Protection Association. But a word of caution .... We must not fall into the trap of only "preaching to the choir" .... we must reach out beyond our own numbers .... and this conference represents that new beginning; we congratulate Dan Bailey and his conference committee for a very broad based participation.

OVERVIEW - National Fire Protection Association

Like the organizations many of you represent, NFPA has always had a commitment to protect man and his environment from fire mainly in the built environment. Certainly, through the publication and distribution of the National Fire Codes, as well as our training and public firesafety education efforts, our member dedication is clear. With more than 40,000 members, and the thousands who serve on technical committees, our Board of Directors and the hundreds of thousands who carry our fire prevention messages deserve the bulk of the credit.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Anthony R. O'Neill, Vice President, National Fire Protection Association, Quincy, MA.

Each and every day our members work to help, encourage, and bring together the people who must apply firesafety information. And this is where NFPA's activities most closely parallel what we're in Missoula to accomplish. For here, we're writing a new chapter in the history of cooperation between the public and private sector, federal, state and local governments in the critical matter of protecting our families, our homes and our lands from destructive fire. And it's even more than that -- like the diversity which brings success to our efforts, this initiative must include not just representatives from the fire services. It must involve architects, engineers, bankers, insurers, builders, developers, schools and families ... to name a few. We see it in everything we do at NFPA, and wildland fires are no exception.

SETTING THE STAGE

I'm not going to take too much of your time this morning talking specifics about the wildland/urban fire problem. However, let me recap some of this year's highlights. Back in March, along with Al West and Clyde Bragdon, I participated in a press conference in Washington on this problem. Back then the press had a "ho-hum" attitude because not much was happening.

Since then, the devastation in the United States has been growing at an incredible rate.

- Nearly 300 structures had been destroyed earlier this summer - including the fires in Pebble Beach, Spokane, and Lake Tahoe
- Thousands evacuated from their homes in Alabama, Virginia, Pennsylvania, California, Nevada, Idaho, Oregon, Washington, Colorado, Minnesota, and Arkansas
- And, by summer's end the property loss value had exceeded 35 million dollars...not to mention the unprecedented costs incurred in fighting these fires.
- In the first week of September, close to a million acres were burning in California, Oregon, Idaho, and Washington severely taxing all of the forest fire fighting forces up and down the west coast.

Let's also take a look at what's been happening outside of the United States.

- Many European nations have suffered terrible wildfire losses over the past couple of years.
- Wildland/urban fire continues to be a major problem in Australia.
- But who among us can forget the photographs from China earlier this year showing the worst conflagration of 1987 .... an accurate accounting may never surface as village upon village fell to walls of flame raging out of control over millions of acres. Thousands were left homeless when the fire consumed one entire town of 25,000 in 20 minutes. The problem surrounds the globe -- it is everywhere.

WHAT CAN WE DO?

So what can we do? First, we must grasp the great extent of the problem and understand that virtually no region of this continent is exempt from this threat. Next, we must develop strategies and solutions.

This morning you heard from leaders who expressed their concerns, and you have heard their appeals for help. This afternoon you will begin hearing from the troops - each with areas of expertise which can effect change.

This week we'll hear about the reality of politics, insurance, and fire protection planning. Throughout the next few days those discussions will delve even further into the intricacies of uniting many different interests - each with their own agenda. The issues will be tough, but they'll help us as we endeavor to apply what we learn here .... back home.

Issues such as turf battles, private enterprise, and homeowner desires are real and can have a decided impact on whether or not community fire protection intitiatives work. Harnessing the support of those who can make a difference like builders, developers, and the media is critical, for they may heavily influence whether or not people even believe the problem exists.

Let me address the media for a moment. When wildfire strikes whether in forests, structures or both - it is spectacular. Its awesome power over everything in its path is overwhelming...and, it makes for great "press."

Right or wrong, people do believe what reporters tell them. So when they show up at a fire, we should be prepared to work with them - this is a prime opportunity to point out the problem and to recommend solutions. Readers or viewers have their interest piqued - it's time to strike. Make sure your media have good information. In a few words, they can spread a message which gets the attention of developers who might have ignored the problem, the city councilor who has refused to believe there is a problem, and the homeowner who still feels the beauty of shake shingle roofs far outweighs their threat of fire.

Multi-Disciplinary Approaches Are Successful

Once you've started breaking down barriers, you can begin bringing together the decision makers in your community. I've talked about who some of those people might be and am sure you can think of others. The important thing is to

include everyone, tying together those with a common interest every step of the way.

For instance, in discussing planning, have the fire services represented along with the city planner, developers, architects and local insurance agents and mortgage bankers. If a new development in a high fire risk area is poorly designed or, because of inadequate roads or water supply, or because it is inaccessible to fire protection services, the development becomes less likely to be financed, and, perhaps, more costly to insure.

Earlier I talked about the NATIONAL FIRE CODES. Written by committees of volunteers, these codes represent what these people each of whom has an interest in the issue from a little different angle - feel will be an acceptable firesafe approach to a design or use. The process - from start to finish - allows for public comment and discussion.

It has been our experience in the built environment that once you get all your leaders focusing in a similar way - allowing for debate and discussion - you will see progress. It's exciting and, more importantly, this progress can mean the saving of lives and property.

NFPA's Continued Commitment

As you all are doing great things at a local or regional level, let me assure you that those of us who are involved at a national level will continue our national focus and our support to you, as well.

The Association I represent here today is committed to the importance of this initiative in all respects: through its publications, its committees, and its membership. Specifically here are some of our recent initiatives:

- The theme of this coming November's NFPA Fall Meeting in Portland, Oregon,

with many sessions picking up angles of the Intitiative pertinent to their membership;

- The "Wildfire Strikes Home!" newsletter, sponsored by partners in the Initiative, has been and will continue to be published and distributed by NFPA to tens of thousands, and

- I'm pleased to report that the NFPA Board of Directors has approved the addition of a Wildland Fire Management Membership Section of the Association. Through this section those existing and prospective NFPA members with a keen interest in this important area of firesafety may come together to share experiences and continue the initiative.

- Our monthly FIRE COMMAND magazine now features a regular column titled "Wildland Fire Management" authored by your Conference Chairman Dan Bailey.

But beyond these latest initiatives ... beyond our committees, beyond what we publish ... I'm here to tell you today, on behalf of the NFPA Board of Directors, as well as the NFPA staff, as well as our 40,000 members worldwide, that the NFPA is deeply committed to doing whatever is necessary to help you ... to help our nation ... solve the urban/wildland interface fire problem.

I've been to many meetings, I've spoken to many groups, and I've been part of many initiatives, but I think that what we will do over the next few days is no less than an historic occasion.

Today, we begin writing a new chapter in the history of cooperation between the public and private sector and among federal, state, and local governments.

We will begin writing this chapter in history, because we have finally come to the realization that fire respects no jurisdictional boundaries ... and because our families and homes are too important to us not to try to seek innovative alliances in our lifesaving efforts.

Looking at the roster of those assembled here ... and the zeal and commitment that I see in each of you ... I'm confident of our ability to succeed in this effort. After all, what better week to rededicate ourselves than this, National Fire Prevention Week. Let's never forget that 116 years ago, this week, the Peshtigo, Wisconsin, wildland fire killed over 1,500 people ..... and yet it was the great Chicago fire that everyone associates with Fire Prevention Week.

Good luck in your symposium and workshop deliberations.

WILDFIRE STRIKES HOME

Al West

This is a significant and vitally important conference. The issues to be discussed are real and there is a critical need to meet the challenges these issues present. We are facing a fire protection crisis of major proportion in the United States.

Since the last week of August, 15,000 people have had to flee their homes; 7 fire fighters have died; and 19 families have lost their homes. Approximately 22,000 fire fighters from Federal, State, and local fire and resource agencies were mobilized to fight some 1,600 fires that blackened about 750,000 acres of land in California and Oregon. Natural resource losses will reach into the tens of millions of dollars. Some 3 billion board feet of timber have been destroyed or seriously damaged. The cost to the taxpayers in this country will exceed $100 million.

A significant factor in this fire situation was the protection of life and property. Fire fighting resources dispatched to protect natural resources had to be diverted for this purpose. This was an obvious and proper decision, but the price in terms of natural resource losses and fire fighting costs was extremely high.

Was it necessary to sacrifice watersheds, the economic livelihood of many communities, the natural beauty, wildlife habitat, and tree growing capability of the land for years to come? If there was no alternative, the answer would be a non-debatable yes. But there is an alternative and that is why you are here. You are the key to reducing the growing losses of life, property, and resources to wildfire.

At the moment, our focus is on the West, but this is very definitely a national problem. This year we have recorded property loss and fatalities from wildfires in 10 states, from the east coast to the Pacific. Most of these losses resulted from relatively small fires, not from major newsmaking conflagrations. The citizen deaths came primarily from debris fires that escaped control, entrapping the people who were trying to stop them.

Since 1985, when the national wildland-urban wildfire protection initiative began, the losses from wildfires have generated sobering statistics. In just 3 years, some 2,000 structures (mostly homes) have been damaged or destroyed, nearly 100 lives have been lost, several thousand fire fighters and citizens have been injured, almost 16,000 square miles have been burned, and the cost for firefighting, property damage and natural resources destroyed will exceed $2 billion.

We have no way of estimating the emotional impact on people who lost family, friends, or personal possessions. How do you place a monetary value on family heirlooms or the emotional impact of a family life shattered by death or the terror of fire? During the recent fires in California many people suffered emotional trauma from the doomsday atmosphere created by the smoke pall hanging over their homes for days. Often the human impact is forgotten when considering wildfire costs.

Neither can the loss of natural resources be minimized. The replacement of soil, vegetation, and scenic beauty could take as long as a century. Our Nation's natural resources are not without limits. When resources burn, we mortgage our children's future. Major wildfires often devastate local economies through the loss of timber supplies or the degradation of scenic beauty. Land planned for homesite development often becomes unsaleable because of the ravages of fire.

We can never completely eliminate the destruction of fire, but it is within our power to reduce the human suffering, economic cost, and damage to natural resources. We have the technology, the management skills, and intellect necessary to dramatically reduce wildfire destruction. The critical catalyst needed is your commitment.

Wildfire does not have to strike home. Homes in the interface do not have to burn and we do not have to continue to sacrifice our natural resources to protect them. People can live fire-safe in the wildlands. We can build fire resistant structures, landscape to reduce fire hazards, and modify wildland fuels to reduce fire intensity. Necessary fire fighting facilities and improvements can be provided.

People living in the wildland/urban interface area can take responsibility for some of their own fire protection. Aggressive and effective fire prevention programs can be developed. More emphasis can be placed on increasing the cooperation between wildland and structural fire agencies. Local governments should be encouraged to develop needed fire codes and regulations. We can involve the builders, planners, architects,

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Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Allan J. West is Deputy Chief, Forest Service, Washington Office.

educators, insurance professionals, and other community leaders in our problem solving efforts.

As Bill Rhatican, Senior Vice President of the Advertising Council, commented: "The Wildfire Strikes Home Initiative is an excellent effort because the focus is a problem that can be solved. Unlike so many problems today that go beyond the capability of the individual citizen, this is an issue where a person can make a difference. Each individual can have a definite influence on personal and community well being."

Your challenge is to take full advantage of the opportunity to develop your abilities and return to your communities as leaders and catalysts for cooperative action that will prevent "Wildfire from Striking Home."

DEALING WITH THE WILDLAND RESIDENTIAL FIRE PROBLEM:

A POLITICAL PERSPECTIVE

Honorable Peter DeFazio
U.S. House of Representatives

Good morning from Washington DC. I caught the end of Senator Melcher's remarks and thought that I might try a little different perspective because I've got a little different background than the Senator in coming to Congress. I've dealt with some of the problems you are dealing with in that I was a County Commissioner before I came to the Congress. And I've dealt with some attempts at solutions to the urban and wildfire interface.

We have, in Oregon where I come from, a comprehensive land use plan for the entire state, and I had the distinct privilege of chairing the Lane County Board of Commissioners as we worked through a comprehensive plan for the rural areas of Lane County. Lane County is about the size of the state of Connecticut, and we have the Willammette National Forest, and the Suislaw Forest and other extensive timber holdings, both private and Bureau of Land Management. So we spent a great deal of time on the question of whether or not homes could be constructed in timber lands, and we actually developed some fairly restrictive rules, particularly in industrial lands. And secondly, to what standards those homes should be constructed, dealing with fire breaks and other issues. So, in a way, we've dealt with some of the things that are confronting you. The interesting thing is that the problem presented to us was not the problem which I've seen in southwestern Oregon over the last few weeks; that is, of the diversion of resources from fighting the naturally-caused wildfires. But the problem presented to us back then was the need to restrict dwelling construction because these dwellings would be the immediate cause of fires. And that did happen in one fire in Oregon this summer, the Bland Mountain Fire, a pretty large fire. But all of our other major forest fires, including the ones that are still going on, were naturally caused, lightning caused, and we had to deal with the problem which you are gathered together to deal with, which is how to deal with the interface. How are we going to deal with limited resources in fighting these sorts of fires which involve both homes and wildland resources?

I don't think it is an issue that the federal government is ever going to deal with directly. It is going to be dealt with at the local level, the county level, the state level, in terms of building construction standards, zoning requirements, and fire breaks, that sort of thing. Those are not things the federal government, except in encouraging education, or through the cooperative fire programs, training, and other things, will ever deal with. I don't believe that we should attempt any sort of national zoning standards.

Right now in my district, we have a good example of the problem we're dealing with. There is a large fire still out of control in the southwestern part of my district. It's called the Silver Complex fire and it is burning in timber land both within and outside a wilderness. There was no one on that fire for almost 10 days. When we had the lightning storm come through, we had so many strikes, we had so many fires, that we had to divert all the resources away from the timber lands to deal with the immediate threat to life and private property. So the decision was made that that fire would be let run. I think that had we been able to get people on it sooner, we could have stopped it--there were a number of opportunities on ridgelines and other natural barriers to stop it. The fire burned into areas that were tougher to deal with and now they're putting lines around 100,000 acres. The result is a tremendous loss of timber value and a tremendous loss of watershed value. And the questions is, if we hadn't had such a conflict in other areas of the state, if we didn't have to divert so many people to protecting homes in forest areas, could that fire have been contained sooner? And I think the answer is yes. Now, that presents a tremendous public policy problem. I'm not about to sit here and say we should let people's homes burn or we should endanger people's lives. That's not the solution. The solution involves the preventative issues that you're dealing with, and I'm looking forward to reading the results of your conference, and hope that you give us some guidance. What do you need from the policy makers in Washington? I know one thing is you need a little more certainty in the federal commitment to this issue. We don't need to threaten cuts every

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Address presented via satellite from Washington, DC at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Peter DeFazio is a member of the U.S. House of Representatives from the state of Oregon, Washington, DC.

year in the cooperative firefighting budgets, which this administration has done. And I certainly will oppose those efforts.

Next week in the Public Lands Committee, (Parks and Public Lands), on the House side, of which I am a member, we are going to hold hearings and do oversight on the fires that occurred in Oregon and northern California and discuss both the ongoing efforts, because it's still very dry and very hot and we still do have fires out of control and posing a continuing threat. We'll discuss the immediate mitigation that needs to go on or the attempts at mitigation before the winter rains hit us. We're going to talk about salvage and reforestation. I intend to introduce the issue of prevention and discuss that a bit and what role, if any, the federal government could have played in those areas.

There's one other thing that is unique perhaps to Oregon, and I'm sure there are some Oregonians there. We did invoke sort of a dusty statute called the conflagration act. The governor was able to invoke that by proclamation in declaring a state of emergency. That allowed the governor to mandate that all the fire departments, the urban fire departments and the rural fire departments around the state, be required to contribute to the forest firefighting effort. I think moving in that direction is a way to deal with the structural problem, to perhaps revisit that statute and make it a little more explicit and perhaps have the federal government or the state get more involved in training of those urban crews. That would result in a large pool of people available to deal with the structural problem so that we don't have to divert as many resources of our trained wildland firefighters to the protection of structures. That is something that warrants a little further review.

I would be happy to take questions and answer them if I can.

Q: What do you feel is our next step to implementing a statewide wildland interface education program?

A: Well, I think one way, perhaps of dealing with this, and it's something that I'm going to discuss with the governor, is the use of National Guard troops. Some people say, well, you can't train up the National Guard every year in the expectation of having a bad fire year and having them ready to go as a trained backup. The same thing in dealing with the urban interface, with the homes and other structures in our forested areas, I tell you, as a County Commissioner, it's pretty tough to enforce the fire breaks and other things that were required in the plan. Yes, we can see when the homes are originally constructed, that the proper standards are used on the new construction in terms of nonflammable materials, that the fire breaks are originally constructed, and that people don't landscape in a way to encourage the fire or threat to their dwelling. But over time, we can't send people back on an annual basis--I don't know of any county in America that is well enough funded to do that--to check on how the fire breaks are doing, whether or not they've modified some part of the structure, or maybe even put on a roof without a permit or something else that would change a roof.

I think we need to concentrate on the years when we know we're going to have a problem. We knew we were going to have a problem this year, and I think the counties and the state need to gear up sort of a contingency program for educating the people who live out there. If you do it every year and it's sort of ongoing, you're going to have people react negatively--"I'm being harassed by the people from down at the County Court House again." But if your approach is "We expect there to be forest fires this summer, we've got a real problem coming up--we've got very low moisture content"--and then gear up for an education effort, for an enforcement effort during that year, both voluntary and involuntary, I think that would be a way to go, and it would be a way to better use the resources. And so, what I would suggest is that we need to gear up for those years, the drought contingency plans for the years when we know we're going to have a problem.

Q: My understanding is that the Senate/House joint appropriations committee recently queried whether federal wildfire suppression forces have decreased since 1980. I would appreciate hearing your findings if they are available.

A: OK. Well, you're referring to the Senate side. My understanding is that there have been significant cuts, that's only in perspective as a new member on the House side, and I'll be getting into the details of that next week. I think these are easily characterized as penny-wise pound-foolish cuts. If we save a million dollars by cutting out a prevention program, the damage in my district alone is 100 to 200 or more times that in loss of just the timber resources, let alone getting into the other natural resources we've lost. We're going to have huge problems with our fishery. So it's a place where the federal government just can't afford to skimp. I will advocate putting as many resources as can be used productively into that program.

Q: Would you support authorization of the Forest Service to train for the protection of structures on or near Forest Service property?

A: As I understood the question, it was if the federal government would provide funds to assist in training for prevention and/or fighting of fires to protect structures that are adjacent to or in forested areas. I think that should be part of the cooperative program. The problem we deal with, as people continue to build in those areas, is how large will that get, how large will the problem get. And if people are knowingly building in hazard areas now, the question is should they essentially be subsidized by the federal government. That's a tough call. I think that in my county where we had problems with water quality, we notified people, "if you build in that area, you may not have a water supply in the

future--there's a potential for problem." I think we should notify people in the same way who are building in fire hazard areas or potential fire hazard areas. "Potential fire hazard exists in this area; you don't have an urban fire department here. We're going to do our best to protect you, but first of all you've got to build the structure in conformity with the standards, you need to maintain these sorts of fire breaks, and we will attempt to train you and your neighbors, volunteers, the rural fire departments, or whatever, in prevention techniques." But when it comes down to fighting fire, we get back to that tough problem--you're probably not going to say to someone, "We're going to let your house burn because we're going to protect that stand of timber over there." That's something that I don't think anyone is willing to say.

Q: You commented that the federal government would probably not be directly involved in urban wildfire development policies. Why not? The development within the flood plain areas are in some ways governed by federally mandated insurance programs.

A: Well, I think the person who asked that question has probably never been a County Commissioner. The question, if the audience couldn't hear it, is why won't the federal government be involved in some sort of national zoning or development standards plan for people building in potential wildfire areas. I don't see it as a federal responsibility. Zoning is traditionally reserved to local governments, with or without direction from the state. I don't think there's any way we could adopt, given the complexities of local areas, a national standard that would fit. You have very different problems in grassland, prairie brush areas than you do in forested areas, or even in different forested areas--ones in southern California, northern California versus the forests in the northern part of my district, or the pine forests out in eastern Oregon. It would be a very, very complex set of standards and I think it is best left to local control, but we've just got to make sure that these efforts are undertaken at the local level, with or without state direction or state incentives or state funding.

Q: Where does, in your mind, a fire protection agency's responsibility end and the public's responsibility begin? Should a fire protection agency spell out its limitations to the public?

A: OK. When the fires are burning, it's really hard to say. I mean, I'm so close to this issue right now, still having problems in my district and having gone through a bad fire season. Where does the public responsibility end or begin, or the individual responsibility, is a really tough question. Like I say, I think we need to concentrate our efforts on the years when we know there's going to be a problem, because if you go back to someone five years in a row and you've got them taking out brush or whatever, the enforcement becomes so expensive, and in fact quite troublesome. I'll relate a story. I own a small tree farm and one of my neighbors had built without a building permit, and the county officials kept coming back to bother the person and say that he didn't have a building permit, and the last time the fellow came by, he took out his 30-30 and said, 'this is my building permit.' Now, the unfortunate thing is two years later the guy's house burned down--it may have been problems in the construction. But there's a resistance to that sort of regulation in our rural areas, so I think concentrating our efforts on the years when we know there's going to be a problem, getting more voluntary compliance, and then doing whatever mandatory requirements we can during those years, will pay a bonus. But on a year-in year-out basis it's a really tough problem to say that 'you, the individual, have the responsibility to do this.' People are away, home ownership changes. You have to keep educating people, you have to keep pushing them. Possibly some sort of notification when houses change hands, notice that you're buying or moving into or building in a wildfire hazard area.

Back to the other question, too, about federal control in the flood areas. It's been a very, very lengthy process and problem. And the only reason that the federal government is exerting that control in those areas is because we have a federal flood insurance program. We don't have a federal fire, wildfire insurance program. And again, that would be where I don't see the federal government getting involved.

Q: Can there be a tax break for people who make their homes more fireproof, such as getting rid of a shake roof, cutting a fire break, etc? As I understand, home improvements such as this makes the tax go up. If a tax break was given, it might give people a reason to fireproof their homes.

A: OK. Of course, the reason the taxes generally go up is because of the improvements and property tax assessments. But I think looking at federal incentives is a good idea because if we can get the people in an area to build their homes firesafe, so we don't have to divert resources, then, again, we are going to save tremendous amounts of timber and other wildlands resources, and the federal government is going to come out far ahead, plus maybe even saving on firefighting costs. So, I think that that's an interesting proposal and definitely something to be looked at, and I'd also encourage local jurisdictions and states who are charged with firefighting responsibilities to review their taxation in those areas.

Q: Should the federal government provide incentives to state and local governments to develop interagency cooperation for fire suppression?. If so, what would be the nature of these incentives?

A: Definitely. In California, the state provides equipment to rural fire districts, and they can use that equipment year-in year-out. The obligation is, when there's a call from the state, when there is an emergency, they have to go. I would look at something along those same lines, in

terms of either the federal or state government working with the local agencies--a program that provides either discounted equipment, perhaps bought through the federal procurement process where there's purchasing in large volumes so you can get it at a cheaper price, direct federal subsidies in some areas, or grant programs. I think any of those would work and just put basically the same proviso on them. If you accept this equipment, you are obligated when we need you, when we have a major wildfire problem, to come. And if we are dealing with urban fire departments, who are trained mostly in structural fires, they would be providing the protection on the structures while other people are working on the wildfire itself. There might also be an obligation for training that goes along with that, to say that, well, if you are going to accept this equipment and you are going to be obligated to come and help in future emergencies, you've also got to keep trained to a certain standard so that you will be more useful to us on the firelines.

Q: Which agency should have responsibility for such a program?

My suggestion would be to encourage the program and whatever agency is appropriate in a local jurisdiction or within a state, whether its vested in a state department of forestry or whether its vested in some other part of the state government or local government. Our governmental structures are so different throughout the West; the same is true in the East, where there is a similar problem, but it is not as apparent this year. Again, there are very different governmental structures. So its hard to detail which one is most appropriate.

Well, my summary would be, give us some ideas. I'm not an expert--you're the experts. It's apparent to me that we have a very real and growing problem, particularly in my region of the West, and I'd like to hear your suggestions. Send them to me, send them to the Public Lands Committee. Be heard. Don't just go to the conference and go home. Be heard and be proactive in your counties, be proactive with your state, and the next year we have a bad fire season, let's be ready.

SESSION 2

William E. Perrin, Moderator
President, Montana First State Bank
Stevensville, Montana

POLITICAL CONSTRAINTS AND OPPORTUNITIES IN WILDFIRE RESIDENTIAL AREAS

Ken Cassutt

My name is Ken Cassutt. I am an Assistant Attorney General with the New Mexico Attorney General's Consumer Protection and Economic Crimes Division. My responsibilities with the Attorney General include enforcement of the New Mexico Subdivision Act, Sections 47-6-1, et seq. NMSA 1978 throughout the State. I spend approximately 80 percent of my time in the subdivision enforcement area.

The views expressed in this presentation are my own and do not represent the point of view, official or otherwise, of current New Mexico Attorney General Hal Stratton. I hope that limitation will not detract from what I have to say.

I have, in a sense, come to this Conference through the back door. I spend very little of my time dealing with fire protection issues. My technical knowledge is deficient. The main thrust of my job is to address past violations of law, in effect reacting to past problems. Unfortunately, this leaves little time to lobby for changes in the law which may prevent future problems.

I have also found fire protection to be a political issue, especially in a state like New Mexico which is trying to grow on a shoestring. The Attorney General's role is to enforce the law with impartiality. Because there are so many laws being broken in so many ways, it is necessary for an Attorney General to set priorities, decide where his time and his staff's time should most appropriately be spent. But this duty to enforce the law impartially to a certain extent resists the politicization of the Office, and makes it troublesome for an Attorney General to be involved in political issues.

It may, nevertheless, be helpful for me to relate what small effort I have made, as an Assistant Attorney General, to encourage counties in New Mexico to pay attention to wildfire hazards in subdivisions. The point of this story may very well be that state government can play a role in educating local governments, developers, and potential purchasers about fire protection issues. Once that education is complete, however, the political tug of war must be played out over the local mud hole.

First, some background on New Mexico's subdivision laws. There are currently 33 counties in New Mexico. Under the Subdivision Act, each county has adopted regulations which govern the approval and sale of subdivisions within that county. While the Subdivision Act sets forth some minimum requirements for subdivisions of a certain size or density, and specifies certain issues which each county's regulations must address with respect to all subdivisions, the counties have wide discretion in determining the types and stringency of requirements they impose upon subdividers. This discretion creates opportunities at the local level at the same time that it permits stagnation.

The issues which a county's subdivision regulations must address do not include fire protection. The Subdivision Act requires regulations dealing with the quality and quantity of water, liquid and solid waste disposal, terrain management and adequate disclosures, among other issues. For most subdivisions, the subdivider's proposals on these subjects must be reviewed by state agencies with expertise in those areas. But there is no specific mention in the Subdivision Act of wildfire hazards, nor is there any prescribed role for the State Forestry Service, in the review of subdivision proposals, even for subdivisions planned for heavily wooded areas.

One of my first tasks as an Assistant Attorney General, in late 1985, was to help convince the boards of commissioners of the various counties throughout New Mexico that it was imperative for them to pay attention to wildfire hazards in subdivisions. This task was suggested by the Council of the Adelante Resource Conservation and Development Area, which encompasses Colfax, Mora and San Miguel Counties in northeastern New Mexico, and includes the easternmost range of the Sangre de Cristo Mountains. I attended a meeting of the Council Board at which two excellent members of our State Forestry Service, Ray Polosky and Frank Smith, gave a bone-chilling slide presentation illustrating the lack of precautions taken against wildfire in New Mexico's woodland subdivisions. I was hooked.

The Council's official request of the Attorney General's Office was that we advise their three counties of each board's legal responsibility to

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Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Ken Cassutt is Assistant Attorney General of New Mexico, Santa Fe, NM.

deal with wildfire hazards and, more impressively, of the potential for liability if the board ignored the problem. We were covering new legal ground. As stated previously, the Subdivision Act does not specifically require the counties to promulgate fire protection regulations. Moreover, county commissioners are generally exempt from liability for negligence under the New Mexico Tort Claims Act in connection with decisions made within the scope of their duties as public officials (Section 42-1-4 NMSA 1978). Between the lack of specificity in the Subdivision Act and the remnants of sovereign immunity, we weren't left with much of a hammer.

After consulting with then Attorney General Paul Bardacke, we sent out a general "newsletter" to all 33 counties, rather than picking on the three northeastern counties, which made several suggestions for improving subdivision regulations, including adding fire protection features. In this letter, we cited a general requirement in the Subdivision Act that counties adopt regulations pertaining to "any other matter relating to subdivisions which the board...feels is necessary to ensure that development is well planned, giving consideration to population density in the area" (Section 47-6-9(A)(11), NMSA 1978). We believed that provision at least provides a justification, if not an absolute mandate, for fire protection regulations. We also suggested in the letter that a clever lawyer representing a family injured or killed in a wildfire may seek to bring the county, or the commissioners themselves, in as defendants. Such a claim could be based, not on a theory of negligence, but on a violation of the commissioners' statutory duty under the Subdivision Act to ensure that development is "well planned." A claim under the Subdivision Act would not be subject to immunity. We therefore toed the line on some legal issues, and in giving the counties an honest analysis, left them with the impression that wildfire was an issue which deserved their attention.

During the following year, a few counties actually adopted subdivision regulations dealing with wildfire hazards. Anita Miller, a dynamic lady who was my predecessor in this position, took hold of guidelines prepared by the State Forestry Service and, with the assistance of Frank Smith, forged new wildfire hazard regulations for Rio Arriba County. Similar regulations drafted by Anita were recently passed by Grant County. The regulations in these counties will be put into play only after the State Forestry Service has, after study, identified areas of these counties in which the risk of wildfire is significant.

Despite these successes, several other counties, in updating their subdivision regulations, have resisted including special requirements for wildfire hazard areas. Our office did not press the issue with these counties, but I wondered what lay behind their resistance. After proposing revisions to the Subdivision Act in advance of the 1987 legislative session, I discovered just how political an issue increased regulation is in New Mexico.

My legislative proposals on the wildfire issue appeared to me to be simple and sensible. All counties would be required by the Subdivision Act to adopt regulations specifically dealing with "designated wildfire hazard areas." Adequate ingress to, and egress from, each parcel would be required at a minimum. Other measures would be within the counties' discretion, so long as the problem of wildfire was addressed. Proposed regulations would be reviewed and commented upon publicly by the State Forestry Service. In addition, any subdivision of more than 24 lots proposed within a wildfire hazard area would have to be reviewed by the State Forestry Service for compliance with the county's new regulations.

I aired my proposals before all interested parties. The Realtors' Association of New Mexico, which speaks for the land development industry on legislative issues in our state, immediately protested. We were trying to add another layer of unnecessary regulation to the approval process for rural subdivisions, they cried. The new regulations would drive up the price of land, making it even more difficult for the poorer people of our state to own their own homes. The entire state could be designated a wildfire hazard area. Why vest authority in a state agency which is not directly accountable to the people? The state would try to impose requirements in the midst of a state forest which were designed for the middle of Manhattan. The only fireflow standards which a rural subdivider could afford to meet would be useless in fighting a typical rural blaze.

The realtors announced that if the wildfire provisions were kept, they would kill the bill. Based on past history, we knew they were fully capable of doing so. We compromised by keeping the ingress-egress provisions. The rest of the proposals were deleted from the bill presented to the legislature.

New Mexico is a relatively poor state. In many rural areas of our state, if land is not sold cheaply, it does not sell. Since there is an irresistible urge to subdivide, this often means that quality and safety are sacrificed to affordability. In most parts of our state, market principles are more firmly entrenched than the fear of wildfire.

There are people in state government as well as the private sector in New Mexico who will continue to push past political stumbling blocks to achieve a reasonable regulatory solution. I cannot represent that I will be one of those people. I hope I may continue to play some role. But it is those on more intimate terms with the play of politics--our elected officials at the state and local levels--who must be recruited by the participants in this Conference. Just as the obstacles are political, the ways to overcome those obstacles must be found in the political arena.

Thank you very much for inviting me here and allowing me to express my views.

HOW ARE INSURANCE PREMIUMS FOR HOMES LOCATED IN WILDLAND AREAS DEVELOPED

Jerry A. Foster

ABSTRACT: Advisory residential fire rates are developed by the application of either the Personal Lines Manual or the Homeowners Manual, both published by Insurance Services Offices, Inc. (ISO). Major areas of consideration are the following:

1. Construction; where the obvious benefits of fire resistive construction over lesser types, such as frame, become evident.
2. Private Protection is reviewed. Some of the items considered for rate credit are:
   - residential sprinkler protection
   - signaling systems (i.e. heat or smoke detectors)
3. Public Protection; the level of public fire protection is measured by the application of the Fire Suppression Rating Schedule (FSRS). The schedule measures that adequacy of both the local fire department and water supply features. Distances to the fire department and water supply is a major consideration.
4. Actuarial and statistical information; calculation of premium loss ratios.

All of these, and more, are considered in developing an advisory residential fire rate in wildland areas.

INTRODUCTION

Insurance Services Office Inc. ISO is a non-profit unincorporated association of insurance companies who have pooled resources to have functions performed collectively for them; functions that each company would have to do on their own were it not for ISO. The obvious benefit is a standard product at a lower cost. ISO provides statistical, actuarial, policy form printing and distribution, and survey work for over 1200 affiliated insurance companies for 16 lines of insurance. Some of the common lines of insurance are liability, automobile, boiler and machinery, homeowners, farm and commercial fire. Prior to the formation of ISO in the early 70's all these functions, for the various lines of insurance, were performed by different organizations in different states. Needless to say there were few common conditions or concepts that existed across state lines, or between lines of insurance.

ISO is not an organization concerned with only one line of insurance, such as fire, in one state or in a group of states; but rather an organization concerned with all common lines of insurance in all states. The significance being that ISO is a total insurance rating organization, and is finding and correcting redundancies, misconceptions and overkills that previously existed. Such improvements have been possible only under a countrywide operation like ISO.

FIRE PROTECTION

The public fire protection that most everyone sees and hears everyday, is the obvious--a fire engine responding to an alarm. This aspect of fire protection is all that many people are ever exposed to and, therefore, is the only relationship they see between fire protection and insurance. However, the truth of the matter is, that once the fire department has been called, there is generally already a loss because something is burning and something is being destroyed. The role that the public fire services do play at that point, however, is to minimize that loss once it has started.

ISO is not in the business of grading public protection, its in the business of developing individual property relativities. The only reason for being at all interested in public protection is to reflect recognition for effective public protection in the individual property rate. Public protection does make a difference in the extent or percentage of loss to value that can be expected in a given fire situation. The tool used to measure public protection is a Municipal Grading Schedule.

The municipal Grading Schedule used by ISO and its predecessor organizations was composite of benchmarks or standards, as some have referred to them, with which the conditions found in a community were compared.

The original versions of the Grading Schedule were not developed by ISO, nor any other rating organization, but rather was developed by an insurance trade association known as the National

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Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Jerry A. Foster, P.E., Director, Classifications, ISO Commercial Risk Services, Inc., Parsippany, NJ.

Board of Fire Underwriters. The stated purpose of the National Board was significantly different than ISO's and other rating organizations. Their purpose was to review municipal fire protection with the objective to influence the community leaders to improve the fire protection being provided. The Grading Schedule was a tool to quantify all of the various fire protection related services that a community provided. The National Board dealt only on a community-wide level and did not get involved in individual properties; therefore, each item they reviewed was only reflected in the Public Protection Classification (PPC).

The state rating bureaus, on the other hand, started with a review of the individual building. It was their job to develop individual property fire rate relativities. Because it was commonly agreed that, with all other variables being equal, properties located in areas with better grades of municipal fire protection should have lower rates, the rating bureaus, as a matter of convenience, used the classifications developed by the NBFU's Grading Schedule.

DEVELOPMENT OF FIRE RATES

ISO is not here with a new story; but rather a new chapter in the old story - relating insurance operations to the fire service. For the first time since the formation of ISO as a major insurance rating organization the various bits and pieces used to develop fire insurance rates are being put in their proper perspective. ISO was asked to discuss only one of those pieces. "How are insurance premiums for homes located in wildland areas developed".

Let us review the rating variables for residential fire insurance which may assist in a better understanding when we discuss the specifics associated with the public protection Municipal Grading Schedule.

Advisory fire rates are published in the Personal Lines Manual and the Homeowners Manual. The manuals are maintained and published by ISO. The following are the variables for consideration in developing a residential fire rate:

1. Public Protection Classification developed by the application of the Municipal Grading Schedule.
2. Distances from a responding fire department and water supply.
3. Construction (frame, masonry joisted or fire resistive).
4. Private Protection; this considers the potential credits for internal protection like sprinkler protection and detectors.
5. Actuarial and Statistical Analysis; the base rate associated to the public protection classification is adjusted based on local and state premium loss ratios.

To the series of charges and credits ISO has mentioned so far, a modification is made for the public fire suppression available in the vicinity of the individual property.

The basic questions being addressed by the incorporation of the public protection classification variable are; what can we expect at this specific location when all of the designed systems in the dwelling fail, and a fire occurs? Can we expect a total loss, or will the loss be minimized by manual fire suppression?

FIRE SUPPRESSION RATING SCHEDULE (FSRS)

In determining the level of loss, a public protection Municipal Grading Schedule is used, titled, "Fire Suppression Rating Schedule (FSRS)". The FSRS produces 10 different public protection classifications with Class 1 receiving the most rate recognition and Class 10 receiving no recognition. Class 9 indicates there is a responding fire department meeting the minimum criteria as outlined in the FSRS. Class 1-8 indicate there is both a fire department and water supply meeting the minimum criteria as outlined in the FSRS.

The FSRS simply defines differing levels of public fire suppression capabilities which are credited in the individual property fire insurance rate.

The schedule contains 14 major items which are used to analyze the fire protection in each and every municipality rated. Credit is given for each item in which compliance is met for the needed conditions. Adding the credits assigned to all items determines the fire protection classification of the municipality. The FSRS is a performance schedule which measures those capabilities of the city which the city themselves control.

With today's high cost of living, to manage and to operate a fire department, the city normally will design their fire defense needs around the average conditions expected.

The FSRS now recognizes this by dividing the schedule into two sections. The first section analyses the average public fire suppression, the second section looks at the few larger individual properties. Neither section one or section two considers sprinklered buildings in the determination of needed fire flow for the city.

The FSRS establishes a needed fire flow in gallons per minute for suppression of a fire in a building; all properties which exceed a needed fire flow of 3500 gpm will be separated so not to influence the evaluation of the city's public protection class. Fire protection responsibilities will now be shifted from the city government to individual property owners. Built-in sprinkler systems, smoke detectors, upgrading construction and other internal fire protection improvements will now become more of an incentive to property owners.

Previous schedules measured such technical elements as reliabilities of the water supply, valve spacing, emergency provisions and other engineering specifications. The FSRS will give

recognition to water availability when that availability is ensured. Cities which can provide the needed water for the appropriate time will find that water-hauling systems or large hose lines will receive the same credit as would a fixed underground water distribution system.

In the past, ISO's grading standards overemphasized such things as heavy equipment, personnel and water supply and underemphasized preventive measures. There was often a low correlation between a city's ISO rating and its actual fire losses.

Changes in the ISO standards now shift this emphasis in general. The new standards emphasize actuarial losses or rates based on actual fire loss history in urban centers and do provide more flexibility in rural areas.

These changes will have a significant impact on city fire safety planning. For the first time cities have an incentive to review their entire fire protection system. These new standards will encourage cities to search for cost-effective means to prevent, suppress and investigate fires.

The public fire protection class is only one of a number of factors that affects insurance rates as already mentioned. Further, in most cases, the other factors generally have a greater effect on insurance rates than the public protection class. If these observations are considered together with the fact that the rates on class-rate properties, which include dwellings, do not change with every change in public protection class, the conclusion is reached that it generally is not possible to justify the cost necessary to produce an improvement in public protection class by the resulting savings in insurance premiums.

We are finding that the larger and better equipped cities that grade as 2nd, 3rd or 4th class, do not necessarily show any dramatic reduction in insurance losses for the smaller residential properties, even though these better classes do cope more satisfactorily with the larger industrial, shopping center or business-block fires. For this reason, the dwelling and homeowners insurance rates in many states, do not show any insurance savings as the public classification improves.

One explanation may be that a fire in a frame dwelling may not require multiple companies and a mass of equipment if the department is alerted promptly, if it gets to the fire soon enough and if the men are well trained for this responsibility.

City officials frequently ask ISO if the savings in insurance premiums that would result from an advance from one public protection class to the next better one would be sufficient to justify the cost of the improvements necessary to produce the change in class. If this were the case, public protection improvements could be justified on an economic basis, and all cities would be class one. This is not the case.

The function of ISO is to evaluate the suppression capabilities actually provided, within the scope of its limited responsibility. The FSRS is the tool ISO uses to accomplish this function.

ISO considers it their responsibility to give to city officials the information they need to understand the insurance classification and the factors that affect it. It is the city's prerogative to make its own decision based upon whatever it believes it relevant to that decision.

THE FEDERAL GOVERNMENT'S ROLE IN MAJOR DISASTERS:

AN OVERVIEW OF NATIONAL, STATE AND LOCAL GOVERNMENT RELATIONSHIPS

Gregg Chappell

ABSTRACT: Presentation on the Role of the Federal Government in Major Disasters: an Overview of National, State and Local Relationships to the Symposium and Workshop on Protecting Homes from Wildfire in the Interior West at Missoula, Montana.

INTRODUCTION

This presentation will address the role of the Federal government in major disasters, and the Federal, State and local relationships involved. However, let us first review how the Federal disaster assistance program fits into the overall role and functions of the Federal Emergency Management Agency (FEMA). The Agency (fig. 1) was established by the President in Reorganization Plan Number 3 in 1978 and involved the consolidation of a number of Federal agencies into a single agency with a wide range of responsibilities for emergency planning, preparedness, response and recovery, and hazard mitigation. FEMA includes the Federal Insurance Administration (FIA) and the US Fire Administration (USFA), the latter also participating in the symposium/workshop. FEMA also includes ten Regional Offices, with boundaries following the standard Federal Regional organization (fig. 2), which administer FEMA programs with the States including the Disaster Relief Program. In administering disaster relief, the FEMA Regional Offices work closely with the State Office of Emergency Services and the designated Governor's Authorized Representative.

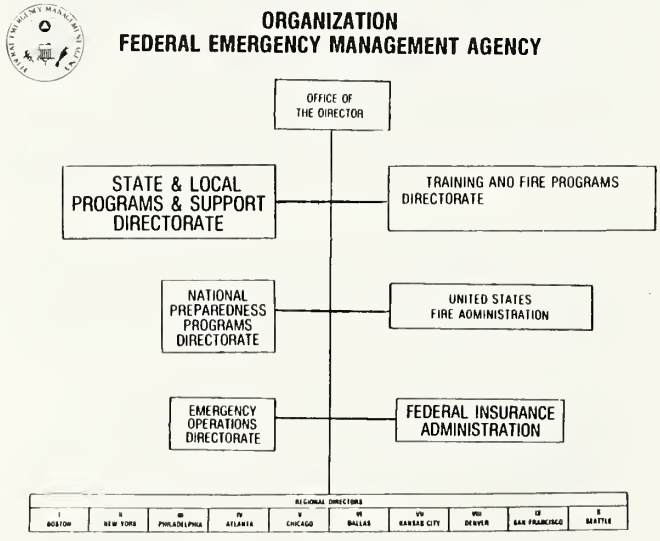

Figure 1—FEMA Organization

DISASTER RELIEF ACT

The Disaster Relief Act of 1974, Public Law 93-288, provides Federal financial assistance for improving state disaster preparedness, and supplementary Federal assistance for individuals as well as state and local governments and certain private non-profit organizations to assist them in recovering from the devastating effects of major disasters. Under Executive Order 12148 the President has delegated this authority to FEMA. The Disaster Relief Act is administered by the Office of Disaster Assistance Programs which is a component of the State and Local Programs and Support Directorate. FEMA promotes an "all hazards" approach in its comprehensive emergency management and we stress the integration of hazard mitigation in providing Federal disaster assistance.

It should be noted that all Federal disaster assistance always is supplementary to the efforts of State and local governments. It should also be emphasized that hazard insurance coverage by

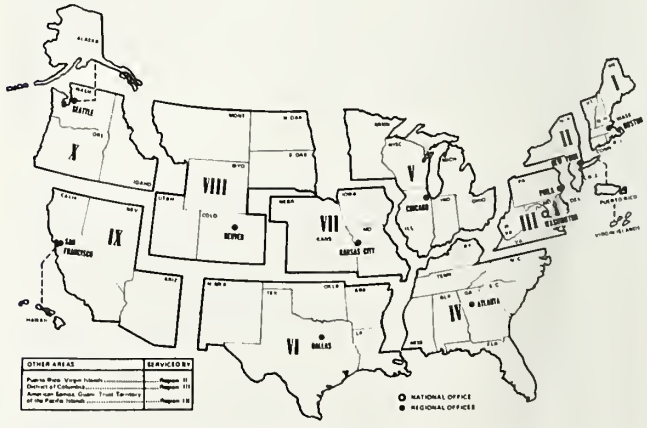

Figure 2—FEMA Regional Boundaries

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Robert G. Chappell, Chief, Public Assistance Division, Office of Disaster Assistance Programs, Federal Emergency Management Agency, Washington, D.C.

individuals and State and local governments further reduces the need for Federal disaster assistance. In this regard, another component of FEMA, the Federal Insurance Administration, administers the National Flood Insurance Program which makes available both subsidized and actuarial insurance to participating flood-prone communities. In addition, disaster assistance may be available from other Federal agencies under their own statutory authorities following disasters, either with or without a Presidential declaration. These include the Small Business Administration (SBA), the Farmers Home Administration (FmHA), the Corps of Engineers (COE), the Federal Highway Administration (FHWA), and others.

A "major disaster" is defined in the Disaster Relief Act of 1974, Public Law 93-288, as any "hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, drought, fire, explosion, or other catastrophe in any part of the United States which, in the determination of the President, causes damage of sufficient severity and magnitude to warrant major disaster assistance above and beyond emergency services by the Federal Government to supplement the efforts and available resources of States, local governments, and private relief organizations in alleviating the damage, loss, hardship or suffering caused by a disaster."

Since enactment of the first disaster relief legislation in 1950 there have been some 800 major disasters declared by the President. The vast majority were a result of flooding although there were a lesser number declared for tornadoes, earthquakes, and other catastrophes. During this period there were thirteen fires including the Chelsea, Massachusetts, urban fire in 1973, the Lynn, Massachusetts, urban fire in 1981, and several California wildfires affecting urban property occurring in 1980 and 1985. A summary of the types of major disaster declarations since the enactment of the current legislation in 1974 is shown in table 1.

The Disaster Relief Act also authorizes assistance under Presidentially declared emergencies. Such assistance normally is limited to meet the specific need for which the emergency was declared. In addition, FEMA has a small program under Section 417 of the Disaster Relief Act which authorizes assistance for States for the suppression of forest and grassland fires which threaten to become major disasters.

Table 1--Major Disaster Summary
(April 1974-March 1987)

NUMBER OF DISASTERS DECLARED BY PRESIDENT 367
TOTAL AMOUNT OF FEDERAL FUNDING .....$3.1 Billion
TYPES OF DISASTER:

	TOTAL	FLOODING	NON-FLOODING
SEVERE STORMS AND FLOODING	228	228	0
TORNADOES	77	33	44
HURRICANE / TYPHOON	33	33	0
SNOW AND ICE	12	0	12
EARTHQUAKE / VOLCANO	6	0	6
FIRE	6	0	6
DROUGHT	5	0	5
TOTAL	367	294	73

DISASTER PREPAREDNESS

States have a vital role in preparing for disasters and emergencies. FEMA is authorized to make grants not to exceed 50 percentum of the cost of improving, maintaining, and updating State disaster plans but are limited to $25,000 per annum. Such assistance is made under the Disaster Preparedness Improvement Grant Program and shared costs are funded under a Comprehensive Cooperative Agreement.

STATE REQUEST

When a disaster threatens or occurs, local authorities take immediate steps to warn and evacuate citizens, alleviate suffering, and protect life and property. If additional help is needed, the Governor may direct execution of the State emergency plan, use State Police, or National Guardsmen, or commit other State resources as the situation demands. If the Governor determines that the disaster is of such severity and magnitude that effective response is beyond the capabilities of the State and affected local governments and that supplemental Federal assistance is necessary he may request a major disaster. The request is processed through the FEMA Regional Office in which the State is located, a Federal damage assessment is made, and the request is forwarded to Headquarters, FEMA, in Washington, D.C., which submits a recommendation to the White House (fig. 3).

DAMAGE ASSESSMENT

Evaluating the Governor's request for a major disaster is an important step in the declaration

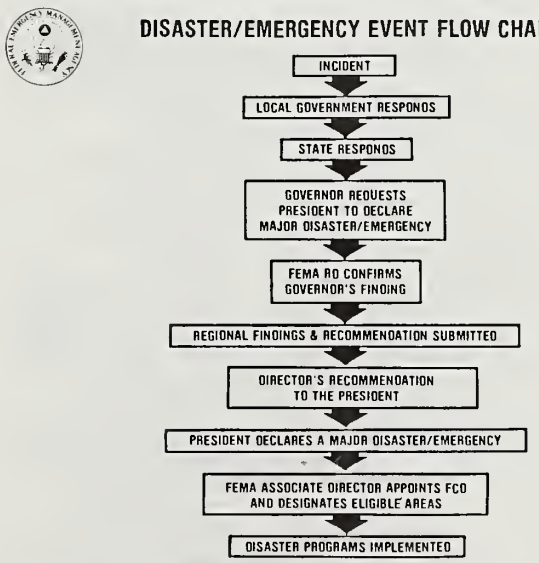

Figure 3—Disaster Event Flow Chart

process and the Preliminary Damage Assessment (PDA) is performed at the FEMA Regional level. It normally includes field surveys of the disaster affected areas identified in the Governor's request and usually is accomplished on a county-by-county basis by FEMA Regional personnel and representatives of other Federal agencies concerned. This may involve door-to-door surveys and include a fly-over of the affected area. Representatives from the State are also involved.

The PDA provides documentation to support the determination that the incident is beyond the capabilities of the State and affected local governments and also provides management information which is used in the Federal response after a declaration. Items which are addressed during a PDA include a determination as to the extent of insurance coverage and probable recovery, the existence of unmet individual needs resulting from the disaster, the potential eligibility of disaster damage for Federal program assistance, and the impact of the disaster on individuals and communities within the disaster area.

FEDERAL RESPONSE

Upon a Presidential declaration of a major disaster, FEMA designates areas (usually counties) eligible for Federal disaster assistance, appoints a Federal Coordinating Officer (FCO) to coordinate the Federal response, and establishes one or more disaster field offices to process applications for assistance from individuals, and from state and local governments and eligible private non-profit organizations, with disaster-related needs. These are referred to, respectively, as Individual Assistance and Public Assistance. Federal disaster assistance is provided pursuant to a FEMA-State Agreement which states the understandings, commitments, and conditions under which the assistance is provided.

INDIVIDUAL ASSISTANCE

A Presidential declaration of a major disaster makes a broad range of assistance available to individual disaster victims. Temporary Housing Assistance is available up to 12 months for individuals and families whose homes are uninhabitable until alternate housing becomes available. Options include a minimal repair program, the provision of rental housing or defaulted government-owned housing, and direct payments for temporary housing. Disaster Unemployment Assistance and job placement service is available for individuals who become unemployed as a result of the disaster. Individual and Family Grants (IFGs) up to $5,000 may be provided to meet disaster-related necessary expenses and serious needs resulting from the disaster. IFG costs normally are cost-shared on a 75 percent Federal-25 percent State basis. Other assistance includes the distribution of food coupons, the provision of legal services, and the availability of crisis counseling to eligible disaster victims. In addition, the Small Business Administration (SBA) and Farmers Home Administration (FmHA) can provide low interest loans to individuals, businesses, and farmers for the repair or replacement of damaged real and personal property which was not covered by insurance.

Individuals requesting assistance normally are processed through Disaster Application Centers staffed by Federal agency representatives who process applications for benefits. This process has been automated extensively to expedite the assistance and to preclude a duplication of benefits among the Federal programs. However, one-on-one contact with disaster victims is most important in order to properly assess their needs and determine counseling requirements. In addition, individual assistance also is provided by private relief organizations such as the American Red Cross, Salvation Army, Mennonite Disaster Services, and other private relief agencies.

PUBLIC ASSISTANCE

Under a Presidentially declared major disaster FEMA can provide Federal financial assistance for the clearance of debris from public or private lands or waters, for emergency protective measures for the preservation of life and property, and for the repair or replacement of public and eligible private non-profit facilities which were damaged or destroyed by a major disaster. Public Assistance normally consists of the reimbursement of eligible program expenses, although in unusual circumstances FEMA has the authority to direct other Federal agencies to provide assistance which is beyond the capabilities of the State and affected local governments. Facilities eligible for assistance under the Act include streets, roads, and bridges, water control facilities, buildings and related equipment, and public and certain private non-profit utilities. Such assistance is cost shared on a 75 percent Federal-25 percent State and local basis.

State and local applicants for assistance normally attend local Applicant Briefings immediately following the declaration during which the public assistance program and application process is explained. Teams of Federal and State inspectors, accompanied by a local representative, survey the damage and prepare Damage Survey Reports (DSRs) which are the basis for a Project Application (PA) for Federal disaster assistance. Following FEMA's approval of the application, interim funding is provided under a Letter of Credit and final payment is made after the work is completed, including any required final inspections and audit. The Public Assistance Program is automated to include the DSR, PA, and funding process.

As in the case of many Federal programs involving the construction of facilities there are a number of special considerations which must be addressed. For facilities located in areas susceptible to flooding a floodplain management review is required under Executive Order 11988 and 11990. The Coastal Barrier Resources Act prohibits most Federal assistance on designated undeveloped coastal barrier areas. An environmental assessment may be required where the facility is substantially changed or where a new facility is built. Flood

insurance may be required under the Flood Disaster Protection Act for Federal financial assistance for insurable structures located in flood-prone areas. And, under the insurance provisions of the Disaster Relief Act, general hazard insurance may be required as a condition for the Federal grant to protect against the hazard for which the declaration was made to the extent that such insurance is reasonably available, adequate and necessary.

MITIGATION ASSISTANCE

Section 406 of the Disaster Relief Act provides that as a condition of any grant or loan made under the provisions of the Act, the State or local government shall agree that the natural hazards in the area in which the proceeds of the grants or loans are to be used shall be evaluated and appropriate action shall be taken to mitigate such hazards, including safe land-use and construction practices. FEMA has been placing increased emphasis on this provision and requires the submission of State hazard mitigation plans in conjunction with all Federal disaster assistance under the Act including assistance as a result of urban fires.

As a recent example, following the major disaster declared for the State of California on July 18, 1985 as a result of urban damage from wildland fires, FEMA Region IX worked closely with the California Office of Emergency Services, the affected local jurisdictions, and other Federal agencies in developing a Fire Hazard Mitigation Plan. The plan identified the risks and hazards contributing to and resulting from the disastrous

Table 2--Fire Suppression Assistance Program

FIRE SUPPRESSION ASSISTANCE GRANTS (PL 93-288, 91-606, 91-79)

Fiscal Year	Program Authority	State Requests	Determination Denied	Determination Approved	Grant Amount ($000)	States Assisted
1970	91-79	1	0	1	$ 713	AK
1971	91-606	4	0	4	1,112	AK, OK, WA
1972	"	0	0	0	0	--
1973	"	1	0	1	48	AK
1974	"	11	2	9	1,096	MT, NM, OR
1975	93-288	3	2	1	77	SD
1976	"	8	1	7	1,304	MN, SD
1977	"	15	9	6	3,731	CA, ID, ME MN, MT, NM
1978	"	5	3	2	203	CO, OR
1979	"	12	5	7	766	ID, MT, NV OR, WA
1980	"	6	4	2	3	CO, WI
1981	"	8	5	3	560	NV, OR
1982	"	1	1	0	0	--
1983	"	2	0	2	94	HI, NV
1984	"	4	0	4	4,916	OR, MT
1985	"	19	10	9	1,778	FL, CA, SD WA
1986	"	3	2	1	146	NC
		103	44	59	16,555	

urban and wildfires, and specified achievable short-term and long-term hazard mitigation actions to be taken by responsible Federal, State, and local agencies.

FIRE SUPPRESSION ASSISTANCE

As mentioned earlier, FEMA also has a small program under Section 417 of the Disaster Relief Act which is separate and distinct from the major disaster provisions of the Act. It results from legislation enacted in 1969 which authorizes assistance including grants, equipment, and supplies, to any State for the suppression of any fire on publicly (non-Federal) or privately owned forest or grassland which threatens such destruction as would constitute a major disaster. Since this program was started in 1970, there have been 103 State requests for assistance of which 59 were approved for a total of $16.6 million (table 2).

Requests for assistance require close coordination between the State Forester and the State Office of Emergency Services. Each request is processed by the FEMA Regional Office which obtains a recommendation from its Principal Advisor in the US Forest Service or the Bureau of Land Management, as appropriate. Following a decision by Headquarters, FEMA, assistance over a pre-determined State floor cost is cost shared on a 70 percent Federal- 30 percent State basis. The fire suppression assistance process is shown in figure 4. FEMA has been working closely with the US Forest Service, Fire and Aviation Management, in improving the program, and also working with the Bureau of Land Management, Fire and Aviation Management, in processing State requests from Alaska.

CONCLUSION

The foregoing presentation provides an overview of the role of the Federal government in major disasters, and the Federal, State and local government relationships involved. It should be noted that Federal disaster assistance always is supplementary to the disaster relief efforts of the affected State and local governments, and is limited to specific programs authorized by the Congress to assist individual and governmental needs not covered by insurance. Relating to the theme of Protecting Home from Wildfire in the Interior West it is recognized that there are important lessons to be learned from past experience with disasters and submit that increased emphasis on the mitigation of both natural and man-made hazards can reduce future losses especially in an era of declining resources. Public education and awareness are keys to successful efforts to mitigate the susceptibility of all natural hazards.

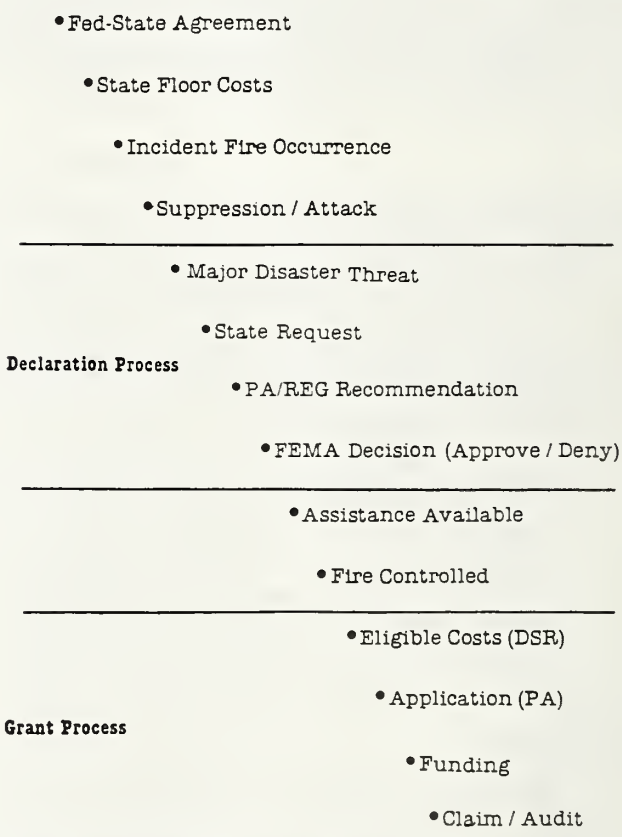

Figure 4—Fire Suppression Assistance Process

FIRE PROTECTION PLANNING IN WILDLAND RESIDENTIAL AREAS:

CONSTRAINTS AND OPPORTUNITIES FOR LOCAL GOVERNMENTS - A PANEL DISCUSSION

Peter Kenney (Panel Moderator)
Gary Tokle
Ann Mary Dussault
Rich Levengood
Gene LaBlanc
Lou Jekel
John Jackson

REMARKS BY PETER KENNEY

I think that this is a very important topic; a topic that this panel will undertake to discuss in a very comprehensive fashion, I hope. Ultimately it seems, from many of the discussions that we've already heard today, much of the responsibility for implementing any good comprehensive and effective wildland/urban interface fire protection program is going to fall on local government. There are some folks who feel that without local government's active participation in the design and implementation of fire prevention programs for these areas, it just isn't going to happen. And to a large extent that is certainly true. We have on this panel a group of people who go right across the spectrum in local government representation, and that is going to give us all a very good opportunity to hear on the one hand about the constraints and the opportunities local government face in trying to deal with this problem, as well as taking a look, on the other hand, at some successes that have been achieved. As I said we've got a broad spectrum represented on the panel. We have three county commissioners, a fire service executive, folks from state forestry, and one representative from the National Fire Protection Association (NFPA) to talk to the topic.

The communities that we represent and that we'll be talking about, run the gamut. I come from a community that you previously heard described as being a very small, rural, mountain community. We're just west of the Denver area, and we have experienced a great deal of pressure from Denver to provide residential communities - bedroom communities for commuters who work in the Denver area. My county line is 30 miles west of downtown Denver and extends to a point about 75 miles west of Denver along Interstate 70 right up to the Continental Divide. We're entirely mountainous. Our traditional, historical population centers have been in the valley bottoms, but that's no longer true. Our largest growth areas are on the slopes of mountains. We're a county where rugged individualism holds sway and where government interference in private property rights is looked upon negatively. This morning we heard Representative DeFazio describe the gentleman who responded to a building permit enforcement with a 30 caliber building permit. In many areas, that person would be considered an isolated eccentric. In certain areas of my county that's the girl next door. On the other hand, some Colorado counties have success stories to tell. One of our speakers is my adjacent county commissioner from Summit County on the west. Summit County is faced with the same types of problems as Clear Creek County. They have similar terrain and development pressures. Through community awareness and because of a different type of population, they have been able to achieve some success in dealing with the wildland/urban interface fire problem. We're going to hear several examples of such successes, and I think that's a very exciting thing to be able to talk about; not only the problems, which are many and you're all aware of them, but also some of the successes that have been achieved and that we can learn from.

Panel discussion presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Peter Kenney is Chariman, Board of Commissioners, Clear Creek County, CO.

Gary Tokle is Senior Fire Service Specialist, National Fire Protection Association, Quincy, MA.

Ann Mary Dussault is County Commissioner, Missoula, MT.

Rich Levengood is Summit County Commissioner/Consultant, Breckenridge, CO.

Gene LaBlanc is Fire Chief, Truckee Meadows Fire Department, Reno, NV.

Lou Jekel is General Counsel, Rural/Metro Corporation, Scottsdale, AZ.

John Jackson is Forest Practices Forester, Oregon Department of Forestry, Prineville, OR.

REMARKS BY GARY TOKLE

The first point I'd like to make is that homes do not have to burn in the wildland/urban interface. With the technology that is currently available, including the understanding of building materials and fuels management, we do not have to have homes that burn in the wildland/urban interface. It shouldn't be a problem. If we accept this premise, then the questions we need to ask is why does it continue to happen, and why is it happening today in areas where it hasn't happened before? In order to address the issue, there are a number of points we need to consider. Local elected officials need to play a key role in resolving this issue. Based on previous discussions among panel members prior to this presentation, I expect you will hear some interesting responses from the local government officials as to how they perceive their role. There is a real need for the local fire officials to get involved and to do things. They need to recognize the problem and they have to start doing things to try to solve the problem. State foresters and state fire marshalls, the two key fire officials in any state, need to start working together to address some of the issues. I've talked with a few state fire marshalls and a few state foresters, and the feeling I come away with is that there really isn't the cooperation and the working together to help address the issues. This situation will be solved only when those two individuals step in and assume leadership and develop needed programs to control the urban spread and to establish building requirements.

I think then that it comes back to this core of key people at the local level. There's a real necessity then, for them to work together to develop public awareness. We've talked about public awareness a lot today, you've seen it in some of the videos. We will probably hear about public awareness more from other panel members. Elected officials, particularly local elected officials, respond to what the public thinks is important. County commissioners are not going to devise regulations and rules to solve the urban/wildland interface problem unless there is public support. You can't ask these people to do that. You have to be a realist. They aren't going to be able to accomplish anything without public support. Unfortunately, if often takes a disaster to generate public support. California just passed legislation giving the state forester authority to make regulations for controlling some of the growth and problems in the urban/wildland areas. This legislation was voted on during the height of the recent fire disaster. It passed unanimously. That was a heck of a lobbying effort.

Another need is cooperation between all of the agencies and all of the emergency organizations, to develop coordinated fire prevention and fire suppression programs. Just about every fire agency has some kind of program for coordinated, mutual aid response, and fire prevention. A lot of you have such programs. They're written down somewhere. You talk about them. But when you really look at the realities of it, there's a lot of you that don't really follow through with them very well. There's a lot of talk about cooperation when we're all sitting together, and then as we walk apart, we go, "Well, to heck with those guys, we'll go ahead and do it the way we want." Really true cooperation must develop.

At the national level, there are organizations that can give you some support. The National Fire Protection Association (NFPA), the U.S. Fire Administration, and the Forest Service. Most of the wildland/urban fire problem, the homes that get burned, are not on National Forest land because people can't build homes on National Forest land. The homes that get burned are in your towns; towns that you have the control over as far as regulations and development and that type of thing. But there's a lot of help that the Forest Service gives through mutual aid in responding to assist you. They also have a lot of technical expertise. They have a lot of people that are very effective at planning and developing community plans that you can draw on to help coordinate or develop some of the programs that you want to implement at a local level. NFPA provides support through the development of standards. These standards are adopted throughout the United States and the world as codes and standards for local jurisdictions. The Forest and Rural Fire Protection Committee of the NFPA is currently developing a standard that addresses the needs of wildland/urban interface areas. Hopefully, once this is developed, you can take it and apply it locally at your level to try and accomplish the things that you need. The NFPA process can lend credibility to the derivation of local standards. It isn't just you, the local fire chief, the local emergency service officer, or whoever the person or group may be. You're starting with something that has been developed by experts and recognized nationally as a valid minimum standard.

REMARKS BY ANN MARY DUSSAULT

First of all, welcome to Montana and to Missoula County in particular. We're happy to have you. Secondly, I have a public disclosure to make. I have little or no direct experience with fires and fighting fires. But being a good politician, I have read a good deal of the literature, and I came to the conclusion that the problem we are dealing with today is certainly complex. It is obviously a multi-jurisdictional problem. It will take the efforts of political leaders, members of the public and private sectors to solve. And of course, a heavy dose of individual responsibility is required. Now again, being a good politician, what I should do is go on from there and tell you how to solve those problems. But actually, since Joe Biden sort of got kicked out of the presidential race, I don't have a lot of material to quote to you. So, what I found I had to do was resort back to my own personal experience. So, I'm going to talk to you about the legislature and the legislative role, and how it effects local government decisions in these issues.

But before I do that, I will relate to you one experience I did have with a fire in Missoula County. A couple of years ago, under a set of very, very bizarre circumstances, the mountain behind us, called Mount Sentinel, was set on fire. The fire was in August I believe, and it spread very, very quickly over the top of the mountain, and into areas behind the mountain where a number of homes are located. Our response teams worked admirably together. They worked well together, and we were very proud of them. A couple of days later, the County Commissioners decided, well, we probably better check on this, right? So we asked for Forest Service if they would fly us over the fire area. And they did that. Well, you need to understand that in Missoula County, we have three women County Commissioners, and it happens we're the first County in the history of the the country to do that. So the other two County Commissioners got to the helicopter, and for some reason, they immediately jumped in the back. And I'm sort of slow on the draw, so I jumped in next to the pilot. I went to close the door, but there wasn't one. So I looked at the pilot and I said, "Listen, I just want to tell you one thing, and you need to watch my lips very closely. You must not make a quick turn. In fact, we will do all turns at square angles, if you please." And he did it, and he was wonderful.

When I made the decision to leave the Montana State Legislature and run for County Commissioner, one of the themes that was prevalent at the time was the whole concept of the new federalism. I found it a very exciting thought that both federal and state governments would decentralize their authorities, pass them back to local jurisdictions, hopefully with a little money to follow, and that local jurisdictions, in cooperation through interlocal agreements and cooperative methodologies, would get about to solving some problems we have at the local level. Well, obviously that didn't happen. Most of the money stopped within about two years. Confusion reigned as the federal government couldn't quite figure out what it was doing with international or domestic policy. State legislatures followed suit fairly shortly in that state budgets became their primary preoccupation. And we at the local level, it seemed to me, were left with a number of problems and not a whole lot of solutions. I assume this is generally true in other States; you're going to have to just sort of generalize my comments to your own States. Since I've been a member of the Montana Legislature, I feel quite free to do a little bit of 'legislative-bashing.' Legislators tend to be extraordinarily paternalistic in their view of solutions to problems. And it's fascinating that as they deal with local governments or local jurisdictions, and I use that in the broad sense now, local governments meaning not only cities and counties, but rural fire districts and other local service districts, that legislators tend to impose a decentralized authority at the local level. And that decentralized authority can make it very difficult for those of us who work in these local jurisdictions when we view a problem, to come up with simple solutions. I mean, for example, if I were the dictator of Missoula County, and maybe someday when I grow up I will be, I would love to be able to define an issue, to bring together a group of informed, intelligent, local citizens, and come to a consensus on the solutions, and then simply impose them. Well, in a jurisdiction like Missoula County, that's simply not possible to do. Take, for example, the fact that Missoula County alone, besides having a municipal fire service in the city limits, has seven rural fire districts. Each of those seven rural fire districts have separate elected boards, and they are separate taxing jurisdictions. As a County Commissioner, I have literally no authority over those jurisdictions. That is the kind of decentralized authority that is popular in Montana, and I believe in many States in the West. Just as an example, in the State of Montana, we have something like 400 individual school districts. In the Missoula County, we have somewhere in the neighborhood of 12 to 14. A very, very decentralized form of government. I believe the legislature takes that position because that's what our constituents want. I remember being a new County Commissioner and realizing that I couldn't simply impose my will on everybody. I went up to a meeting in Seeley Lake, which is an unincorporated community north of us about 80 miles, and they were just beating the heck out of us about something or another, and I finally said, "Look, you know, I hear what you're saying and I understand the solution that you want, but you've got to understand that I don't have the authority to do that. The legislature simply has not delegated that kind of authority to County Commissioners." And I said, "I want you to know, I find that very frustrating. I would be able to do that for you. I would like to be able to do that. I would like to be able to solve that problem. But I can't." And some guy piped up from the audience and said, "Yeah, and you know what? That's exactly how we want it! We like having you frustrated. We like having control over you. And that's the way we want it."

So, legislators I believe, reflect the constituents in that view of decentralized authority. It makes it very difficult for us at the local level because what we have to do is use a lot of the mechanisms that you've already talked about, and that were just talked about, to come to solutions to problems. We simply can't impose them necessarily through the regulatory process. We must use alternate methods in order to get to those solutions.

The next thing I love about legislators is that they simply refuse to make a decision when they don't have to, and they will avoid making a decision at any cost. And having sat there for eight years, the one thing that I noticed is whenever you had a constituency that was divided, legislators loved it. If you had a coalition that came in and fell apart or a constituency that was divided and not speaking to you with a single voice, you can just say, "Look, you can't decide on what the solution is, and I can't decide on the solution. You go home and figure it out, come back in 2 years, and tell me what to do." A

complete avoidance of making a decision. One of the rules of dealing with those folks is a consolidated constituency or a consolidated coalition. Such a group has extraordinary power because if a coalition speaks to a legislative group with one voice, and won't let them off the hook, the legislators have almost no option except to agree with you. It's an extraordinary phenomenon. If you've seen it work, you know what I'm talking about. It is amazing.

Let me tell you very briefly about a couple of memories that I have. I served on both the local government committees and the public health, welfare, and safety committees at different times during my career. And more often than not, constituencies came in divided. A classic example was between urban firefighters and rural firefighters. I don't ever remember talking about issues. I remember talking about turf and territory. And how "We're going to protect this turf or territory over there, but these folks here somehow want to get a piece of it." Now, I'll tell you may favorite story about that, and I won't use firefighters, I'll use psychologists. And it's true. It was about psychologists, a classic example. One group of psychologists who didn't happen to have Ph.D's came in wanting certain authorities under the law to prescribe certain kinds of treatments. Well, the Ph.D's came in and, by gum, "they couldn't do that, because these folks obviously don't have Ph.D's, and you can't let them do that because they don't know what they're going to do. And it's not going to be in the public welfare and the public's going to get hurt, and the world is going to fall apart." So we listened to this sort of parading about for two or three days. Finally, the chairman closed the testimony. There was this little, little, little, I mean tiny woman, on the committee. She'd been sitting there for three days listening to this, and she'd been chain-smoking all the time. Finally, the chairman said, "Have any of you got anything to say?" And she said, "Yeah." So he recognized her and said, "Representative Hurlaby, you have a comment?" And she said, "Yep." She said "Mr. Chairman, I've got one thing to say." She said "Thermometers have degrees, and you know where they stick that."

Another thing to remember about legislators is their agenda is probably not yours. Most people go to the legislature because they are interested in a particular subject matter, and that's what they're there for. If you look around in Missoula today, there are probably 15 different groups like this, meeting and talking about things that they have to do to get their legislators to change. But there are very few legislators that know one whit about what you're talking about here today. And we always think that what's most important to us is most important to them, and it just ain't true. So it's extraordinarily important to choose what I call a couple of winners from both sides of the aisle. To inform them, to educate them, and to bring them up to speed so that they can speak for the issues that you care about. Because, believe me, most of them don't care, and don't take that personally. It's not meant to be personal. It's just that their agenda is going to be more likely issuessuch as taxation, budgets, water, whatever it is that drove them there. And you have to capture their interest, find a spokesman, get to them, and get them to pay attention. That's an information and education process in and of itself.

Finally, as you well know, they are reactive and not proactive. It's extraordinarily difficult to get a legislative body, and this is true I believe with a legislative body like a group of Commissioners, to think proactively instead of reactively. We respond far better when there's been a problem and we can find a simple solution rather than worming our way through the complexities of trying to think how to prevent something in the future.

My advice to you is simple. 1) Pick those few winners. Inform them. Educate them. Get involved with the political process and make them your allies. 2) Develop very strong coalitions, not only among yourselves but among other entities, for example, associations of counties. The possibilities for coalitions are endless as long as you agree that you will agree on a couple of things and if you disagree on other things, it's fine. They won't fall apart. 3) Leave turfdom out of the legislative process. It doesn't get you anywhere. It simply hurts your cause, and it doesn't enhance your credibility. And 4) encourage the legislature over and over again to de-escalate the attitude of paternalism, and to delegate more and more to the local level so that folks in the local jurisdictions have the authority to make decisions to solve their own local problems. It's my belief that if we do that, we can start to change the processes that causes the horrors I read about in the literature; the horrors of fires, the horrors of homes being burned, and the horrors of people dying. And I'm going to steal a quote. For local officials, by the way, every time we have to sit and make a decision, it's like a horrible time. You've got to make a decision and 50 percent are not going to like what you did, and 50 percent are going to like what you did, so you've lost 50. I call that a horrible ending. But, in my opinion and this is the quote I'm stealing, "It's better to have a horrible ending than horrors without end."

REMARKS BY RICH LEVENGOOD

You've all heard of a yuppie. In case you don't know, a yuppie is a guy who lives in the innercity, works in a high-tech job or a financial firm, and drinks Corona beer. I'm a "marpie", and that is a "middle-aged rural professional," and that's the kind of area that I'm in. I go to a lot of wine and cheese parties, I have a pair of skis, a 4-wheel drive, and a butterfly net. That's what distinguishes me from a yuppie.

Today I'm going to concentrate on land use planning and regulations on the local level and the necessity for cooperation between units of various governmental levels, developers, and private

citizens. I am going to use Summit County as a case study.

I am not a firefighter, but I certainly deal with a lot of firefighters. Today, I'm going to deal with the political process rather than fire statistics and firefighting techniques. Those are things that I don't know anything about. But I think I do know about the political process and the land use planning process.

Let me give you a little profile of Summit County. First of all, like Commissioner Dussault, we have in Summit County 7 fire districts, 6 towns, and about 20 other special districts. Let me give you a little idea what Summit County is all about. We're a recreation county. Our permanent population in 1980 was 9,000, and our peak population was about 50,000. By 1987, we had grown to 13,000, and we have around 78,000 or 80,000 estimated people on any given day in that county. By the year 2000, we'll have 20,000 permanent residents, and 124,000 or 125,000 on any given day during peak. That will be mainly in the winter. But we indeed have a summer economy also. In housing units, we've got about 16,000 housing units. Thirty-six percent of those units are owned by the primary or permanent residents, and about 64 percent are owned by second-home owners, primarily from the front range of Colorado which is approximately 2 million people. Skiing is our main industry. A third of Colorado skiers ski in Summit County - 3 million out of 9 million. We have four areas there: Breckenridge, Keystone, Copper Mountain, and Arapahoe Basin. In a just released statistic from the Census Bureau, we were among the top 5 percent in terms of population growth in the United States. Out of 3,000 counties, we ranked about 130th, I believe. Summit County is a relatively small county. Interstate highway 70 dissects it. It's about 600 square miles and about 75 percent of that, or about 290,000 acres is National Forest land managed by the Forest Service. It's heavily forested. We have one Wilderness area and development abutts both the Wilderness and other National Forest land. We have a great deal of development in those areas.

What does this profile suggest? I'm sure that this applies to many other counties in Colorado and indeed, the entire West. If you're not a ski county, you're certainly a recreation county or a second-home county, and you most certainly have federal land.

First, there's an increasing and accelerating wildland/urban interface problem in Summit County. I'm sure that's true with respect to many of your areas. Second, there is an increasing and accelerating and indeed urgent challenge to all levels of government in Summit County to get their act together. The Forest Service, for example, manages 75 percent of the land. They fight fires. They're a multiple use agency. The State Forest Service helps local governments in planning for prevention of wildfire. Local fire districts concentrate on structures, but they are certainly concerned with wildland fires. County and city planning commissions are where your land use regulation and approval lies, so they've certainly got a challenge themselves. Locally elected Boards and City Councils; however, must set the political stage for the acceptance of regulations with respect to the wildfire/urban interface.

The locally elected officials are the Mayors, the Councils, the County Commissioners, and your fire district directors. In Summit County alone, we probably have about 20 or 30 different boards that we have to deal with, most of which are elected. Primarily what happens is they look to the three County Commissioners for overall guidance and coordination. County Commissioners are in charge of the planning commissions and building codes and other local controls relating to development.

The challenge, and this is principally for the locally elected officials, is to keep structural fires away from the forests and vice versa. How is Summit County meeting this? We've had some success in this area. We certainly are reacting positively to the wildland/urban interface in our county, because it reflects positive public acceptance to our addressing the issue. That is extremely important, and that is the first thing. If you don't have that then you don't have anything.

The State Forest Service has designated wildfire hazard areas, and the counties adopted the regulations, the maps and so forth, that they have issued. I believe that this started in about 1974. Our developers are required to identify wildfire hazard areas. Any time they develop anything, they are required to give us a map so we don't have to go around guessing about it. We check them through our planning department. In the last 15 years, Summit County has enacted subdivision zoning regulations and construction design regulations that tend to mitigate the problem. As in the case of New Mexico, the State of Colorado allows local governments great discretion in regulating development. And we've exercised that discretion. There are certain areas where we simply prohibit or greatly restrict development. For instance, dead end roads that don't have cul-de-sacs; areas having over 30 percent slopes, and "chimney fire" areas.

One of the most important areas that we've gotten into is to foster intergovernmental cooperation. I've heard about that here all day, but it is really the truth. We have adopted general policies regarding land use development standards, codes, amd regulations that allow local governmental entities, (that is other local governmental entities such as your fire districts) and developers the flexibility to negotiate subdivision agreements and put in subdivision improvement contracts when both such governmental entities and developers sign off with the county. We've done that pretty successfully, though not evenly throughout the entire county.

We have adopted a second way to foster inter-governmental cooperation and developer acceptance. Believe it or not, we have managed to adopt fairly rigid subdivision design criteria that must be met. For example, two-way access,

firefighting water supplies, road grade maximums so trucks have access, and minimum standards on road curves and widths and driveways. We even limited the length of a cul-de-sac. A developer can probably exceed the 600-foot maximum, but there has to be some real mitigating circumstances to do so, and it requires fire district compliance or "sign off" and review. (Sometimes, this latter is tough for County Commissioners to accept, let's not fool ourselves.)

We've also adopted regulations for subdivision design criteria that are general enough so that fire districts and the State Forest Service can fill in the blanks, generally in direct negotiation with the developer. Sometimes, a county planning department by itself simply does not have the appropriate criteria to follow, and we have to rely on other agencies to help us. An example is the area of tree thinning for firebreaks. We actually require the developer to work with the Forest Service, the State Forest Service, and the fire districts in tree thinning. We've adopted building codes on sprinkler systems, roof covering, and fire resistant building materials. These are requirements. The overall idea is to keep forest fires away from structures and prevent structures that are on fire from starting forest fires.

Another factor that's very, very important is that we have a follow-up process. We're not expert at it, but we're getting a lot better at it. And the way we're doing it is we enter into subdivision agreements with developers to guarantee implementation of the mitigation methods in the agreement, which is secured by the developer via a letter of credit. But, again, we couldn't do it if we did not have general political acceptance of this approach in Summit County.

There is also another thing that we try do. We try to emphasize cooperation rather than competition among private citizens, developers, and other agencies of government. We're not interested in who's going to win. Because I think if anybody wins it's going to be us all if we work together. That sounds like a trite phrase, but it's really the truth. We simply are not interested in arguing with anybody. We want to get the job done. We've got to much to do in Summit County, we've got too much growth, and too many other issues to do it any other way. It has been my personal experience that the very citizen we are charged with serving is usually the loser in a competitive situation involving several governmental agencies, when he as a developer or individual citizen is caught in a whip saw, so to speak, between competiting agendas.

There are constraints. One is public attitudes. We've heard about that today. In Summit County, most people don't want to live in the tract developments; they want to live in the pristine wilderness. The State Forest Service recently thought up a novel way to get around some of the problems this creates. They took flags and actually went out with the developer and flagged in red the trees that were going to be kept, and then flagged in blue the trees that would be cut. That proved to be a good device for that developer and the prospective homeowners to buy into.

We've got old stands of mature and diseased timber both on our public land and our private land. There's plenty of it - there's plenty in my neighborhood. Some people want to hold on every stick of dead and diseased lodgepole pine on their half acre, and they want their neighbors (and the Forest Service) to do the same. That attitude represents a political constraint. Probably the worst thing we've got, and this applies to Colorado in general, is that the wildfire regulations set down by the State Forest Service and the hazard maps developed by the State, are merely optional for local governments. The gentleman from the New Mexico Attorney General's office said there were only two counties that adopted them there. I don't know how many Counties have in Colorado, but I would suspect a few more than two have done so. Even within Summit County it's uneven. We've got good compliance in the Breckenridge area, but we have rather spotty compliance when it comes to intergovernmental cooperation and working with the fire districts in other areas of the county, primarily because they just don't have sufficient resources, they haven't developed those resources, or are unwilling to do so.

And finally, another constraint is developer economics. I know a developer who has a development that backs right up against the Eagle's Nest Wilderness Area. He voluntarily cut back and thinned trees for a half mile all along the Wilderness area boundary on his property. I recently talked to him and I ask, "Would you do it again?" And he said, "Hell, no. I did it then because lots were selling good." But he said, "Now, lots aren't selling at all." He said, "It's strictly a matter of economics. I'd fight you to the end if the county required me to thin out trees now." So we would have some resistance there, and you always do whenever you get into economics.

In the future, as far as Colorado is concerned, we need to have wildfire hazard regulations that are mandatory and regional. Fire knows no boundaries. I compare it with the economic development commissions that are springing up all over, I think probably all over Montana and certainly all over Colorado. They're usually on a regional basis. I can't see any difference between that and fire regulations, particularly in the wooded areas such as where Peter Kenney and I reside. It should become part of the landscape, like handicapped access codes have become and like the Clean Water Act. I know, as one county, we've certainly responded to the Clean Water Act of 1972. We're experts at it. We want to be experts in the fire prevention business. At least I do. But I don't know whether we're going to get there individually. I don't think we are.

The second thing is that I think we need more working conferences on the substate level, rather than at the legislative level. The latter is not where the action is. The problem is going to be solved, if at all, on the local level where land use review takes place. We may need legislative

action. We may need federal action in several areas, but compliance and solutions really start on the local political level.

The third thing is that we need more political awareness. It's essentially a political problem of good land use systems and safe development. And I think where it begins and where it ends is on the local level, where locally elected representatives can frame policy in cooperation with building departments, planning commissions, fire departments, U.S. and State Forest Services, homeowners, and private developers.

REMARKS BY GENE LaBLANC

I am a fire chief who works for County Commissioners. I have five elected County Commissioners, but I don't think I have the problem that's facing you here in Missoula. I would like to talk to you a little bit about how, as a fire chief, we try to address the issue of the urban interface by talking about how we work with developers to get through the issue of how a developer is going to build in our area. If a developer wants to come in and put in a subdivision, he needs to go through seven major steps before he can actually start building. The first time a developer is interested in development in our area, he needs to set up an appointment with our planning department. At that time, as soon as the developer walks in the door of our planning department, the planner encourages him to sit down with all the agencies involved--the fire chief, the sheriff, the water and sewer folks, etc.--and just have a kind of preapplication meeting to discuss in a very general way, what this proposal is going to be. At this stage of the game, there's no secrets. If a developer is going to put in a subdivision, then the issue of fire protection comes right up front before he has a lot of money and a lot of energy put into the subdivision.

The next step is to set up what we call the tentative review. This is a review of the design, the conceptual idea, the proposed subdivision, what it is going to look like. At that time, we at the fire department get a chance to take a look at the subdivision. We look at the present impact level that we have and address such issues as future fire stations, fire station locations, and in some cases we've even insisted on a specialized piece of apparatus if we feel we don't have one close enough to take care of the situation. We certainly get into the issue of egress and ingress, and we require at least two access routes for the general public, and in some cases we require additional access for emergency vehicles. We also discuss in very great detail the issue of water, and water hydrant systems because in our area we don't consider cisterns as an adequate water system. We get into the issue of the wildland. We require fire or fuel breaks and we require thinnings and clearings around the areas. Fortunately, we have a very active division of forestry, the conservation program, and a lot of inmates which can be utilized by the developers to reduce the fire hazard. We also get into the issue of proper clearing around residences, and we get into the sticky issue of fire resistant roofing materials. Probably the most important thing we do at this stage of the game is to advise the developer that if he's going to get into the development business, he must set up some method for maintaining the open space after he develops the project and before he splits for California.

At this stage of the game, the developer has now received our recommendations in writing. He then sits down with the regional planning commission and all the staff members and goes through a formal application in which conditions are listed alphabetically through the process. When it comes to the fire issues, you're looking at maybe six to seven issues that he must address.

About six weeks later, the developer is now in a position to appear before the regional planning commission for a formal hearing to address the subdivision. This is the first public hearing. It's our philosophy that we try to avoid any major disagreements at this stage of the process. If we can't come to an agreement with the developer at this point, then usually his subdivision has got a lot of problems. We try to avoid the issue of fire protection versus the whole conceptual idea that 'I want to build a subdivision here.' Once the public hearing is held and the regional planning commission makes a recommendation, either approval or denial, then the final decision is made in front of the County Commissioners.

Then, we've added what we consider probably the most important step. If the County Commissioners approve the subdivision, the developer, before he can develop it, must come back with a handbook in which he addresses in writing every single condition and explains his solution for each. Then the agencies, the developer, and the County Commissioners sign off on it. At this stage, the developer can start his subdivision.

I would now like to walk you through a development that just occurred in our area to give you an idea of where we're going. For perspective, however, let's first consider a subdivision that was developed west of Reno in the late '60's. Obviously we didn't do a very good job of addressing the issue of urban/wildland fire protection back then. The vegetation is sagebrush and native junipers on steep slopes. Houses have shake shingles and big bay windows. Access is poor and there are no fire or fuel breaks. The potential for a wildland fire is high and control would be very difficult, if not impossible.

Now let's talk about Collins Ranch, a subdivision that came in after we'd adopted our master plan. Fortunately we're in a situation where this is the last major subdivision that's going to occur between the city of Reno and the Toiyabe National Forest. It's a rather large subdivision. We're looking at an area exceeding 3,000 acres and we're looking at a subdivision that's going to have over 4,000 residents plus the typical commercial area. To deal with the planning for this development, we took advantage of experts from the Toiyabe National

Forest, the University of Nevada, and our State Forestry Department. We had, therefore, the advantage of a group effort to address this problem.

One of the problems we had was the issue of access. We required two accesses for the general public in and out of this subdivision plus some additional emergency access for our own fire apparatus. We took advantage of a lot of green belts and the issue of water rights that this development had. Green belts, or open space within the subdivision, provide positions to either hold a fire or start backfiring operations. We required the developer to clear the native vegetation in some areas down to bare mineral soil and to come in with an irrigated landscaping system to address it. Yet we left the ponderosa pines and some of the junipers in place in a landscaped environment. We required roads to be paved, and if they're 32 feet or less, you cannot use them for parking.

This particular developer was interested in utilizing some hiking trails, some jogging trails, and some horse trails. Sitting down, we agreed that we also needed access to get behind some of the lots. We eventually agreed that we could utilize the recreational trails for our small brush trucks, not our Type 1 engines, but some of our Type 3 and Type 4 engines to give us access to the back of this subdivision and into the open spaces behind. These hiking and biking trails go all through the subdivision and allow us access to almost everybody's back yard. Some of the trails are unimproved, but we still can get access with our fire apparatus.

Although the State of Nevada has a law that actually designated high hazardous areas, this development was already started when some of the boundaries were redefined. So we had some political problems trying to get this development totally involved here. We require, if they want to retain native junipers--which is a big issue out here--the installation of an irrigation system.

We took advantage of some of the native water present, and they helped develop some of the waterways, and then got into planting grasses. So this gives us a pretty good, adequate fire fuel break going through the subdivision and around some of the edges. The juniper was left in place and, in fact, the developer is now planting ponderosa pines to bring back some of the native vegetation. Hand crews came in from the State Forestry and pruned the trees, removed all the dead fuels and some of the dead branches.

We required a Class A or Class B roof in this subdivision. We did run into a situation where we had been fighting on individual lots or with individual homeowners over the issue of shake roofs. Some of the agreements we made allowed that if they would remove some of the native vegetation, including some of the junipers, get back into the issue of landscaping from the irrigated point of view, we'd take a look at it from a city point of view. We did finally end up accepting treated shakes, but we're not convinced that 10 years down the road, we're not going to start having problems with some of these treated shakes. I can't believe the amount of energy we put in with people building houses and architects. We would get into horrendous arguments over the issue of treated shakes versus a tile roof. Where we allowed treated shakes we also required extra vegetation removal.

A complete hydrant system was required throughout the subdivision. As I mentioned earlier, we don't consider cisterns to be adequate.

One of things that we're trying to impress upon the developers is that as a fire chief responsible for a fire district, I cannot guarantee adequate fire protection at all times. In this particular area, we feel that the developer has created some of the problems because he did in fact purchase a piece of property and did start to develop it. We are telling the people who live out there that there is some risk and they need to address this risk. As you saw in a news clipping earlier this morning, they had a fire in Carson City which just lies south of our area, where the landowner said he saved his house because the State Forester told him a few weeks before that he needed to clear his property and he cleared it. This particular house did not have a fire truck on it when the fire ran through. So I think the citizens in the area need to accept some risk and not be in a position to feel that every time there is a fire, they're going to have a guaranteed fire truck sitting in their yard, because this may not be the case.

REMARKS BY LOU JEKEL

Commissioner Dussault told us how to deal with legislators. I'd like to take a few minutes to talk about how to deal with commissioners. What's intersting is that we're lucky, Chief LaBlanc has apparently some good strong zoning controls in his county. Frank Smith and the assistant Attorney General from New Mexico have some potential, but apparently New Mexico has not really caught on like it should. Colorado's Summit County seems to be great, but some neighboring counties aren't so good.

My main job is representing developers which sounds like it's the opposite of what we want here. But what's interesting is that all of the developers that hire me in Scottsdale know my involvement with the fire department. We never have any problem with fire codes or with their fire safe situation, because I won't deal with them unless they're willing to basically follow the codes without question. Scottsdale has been a leader, and it hasn't been easy. As I'm sure some of you know, we have a residential sprinkler code as does Palm Springs and some other cities through the United States, which presently requires all new homes that are built, no matter whether they are single family or multi-family, to have sprinklers. Everything in our city is has sprinklers. This helps greatly in terms of reducing the cost of fire protection to the public. There are some good trade-offs too. We allowed different hydrant spacing, smaller mains, use of gray water and several other advantages. Some of the resorts use gray water out of the ponds that they use for the golf courses,

particularly if they have a shortage of water. So all of these systems are taken into account to meet their fire needs.

The way we got the sprinkler ordinance through was going to several leaders in the community who were in the home building business. The primary one had been a past president of the Chamber of Commerce. Going to a person who is that active in his community, telling him what it means to the community to have this type of a life-saving system built into the homes, he was able to understand and support us. And after several of the big home builders fell into line and supported us, we were able to get this through. There was a lot of screaming and gnashing of teeth, but now you see home builders advertising all over the place that their homes are fully equiped with sprinklers. So, not it's part of the sales pitch.

Zoning represents one of the best ways to make a community fire safe. You can talk about buying more fire engines and hiring more firemen. You can talk about more cooperation, and we definitely need to talk about more cooperation. but, you cannot plan and be prepared for the type of fires that recently occurred in California or in Nevada, every minute. You cannot afford that. So how do you do it? You do it by zoning.

You've heard the word zoning all day, so let me tell you, for some of you who may not know exactly how it works or what it is. Zoning is the legal use you can put your land to. Zoning and zoning districts, zoning regulations and districts, keep slaughter houses from being beside homes. They keep, hopefully, airports from being beside homes and put them beside industrial areas. They keep homes from interfering with commercial areas. Now, Houston is a big city that doesn't have zoning and you can tell it when you go there. Practically every other metropolitan community has some form of zoning, and most counties have some form of zoning. But the effect is that what we need to do is go to our County Commissioners and convince them, when they have the options, to put in the zoning and subdivision regulations. In some states, they're available, some states they're not. Where they're not available, where they do not have enabling legislation, then we need to go to our state legislators and get them to put in enabling legislation. Effectively, what you are doing, and what we can do in the fire service, very much like Chief LaBlanc is doing, is you go and you keep your own people who are involved, your own fellow county and city employees, to teach them, first, what you need in the way of fire safe areas. Then you educate your planning commissions, your planning zoning commissions, your city councils, your planning commissioners, and get them to adopt only those subdivisions and only those zoning cases that allow and provide for safe access, and you've heard all about ingress and egress and hydrants and sprinklers.

You have an opportunity in almost every jurisdiction that I know of, of two public hearings before a subdivision plat is adopted and before a rezoning is adopted. For example, if a person has a big piece of farmland or a big piece of rural land and wants to put in a bunch of homes close together, maybe multifamily, that has to go before two public hearings. The fire service can enlist the aid of, not only your own people that you work with, but environmental groups and other groups that are interested within the community. They can go to those hearings and they can protest if these plans do not provide for everything you need in terms of the fire protection. Now, it's going to be a long battle before bringing some counties to the level of the Truckee Fire District outside of Reno. It is going to be a long time before you get to areas like Palm Springs and Scottsdale, which have, in some people's minds, outrageously strong codes. But in getting there, what you can do is improve the status of protecting the wildlands as you go along.

We've talked about constraints. What are some of the constraints?

1. Weak enabling legislation. It's very possible that you need to have the State Legislature give the counties and cities more power to put in these kinds of regulations.

2. Lack of 'home rule' for counties. We talked about that at lunch with the county people.

3. Uninformed legislatures and legislators who don't care, as we have heard from Commissioner Dussault, about anything that is not squeaking. If it isn't broken, if it isn't squeaking, if they don't hear about it, they don't want to be involved.

4. Boards of supervisors can be terribly unresponsive if you don't bring it to their attention. The people I think who are here, and more in the wild areas, are much more attentive to this. In Maricopa County, we at Rural Metro, went to a Planning Commissioner and said, "Look, we need hydrants in the subdivisions." This was about 10 or 15 years ago, and were able to get the county to put hydrants in the subdivision regulations. That alone, basically changed our lives in the county. Because trying to fight a fire in a county as big as Maricopa County, which is the third or fourth or fifth biggest in the United States, without a good hydranting system and without good subdivision regulations, is a very difficult task.

5. The public needs to be informed. Developers need to be educated. An uncooperative or an uneducated fire department needs to be brought into the fold. We have the opportunity to build fire protection systems into our homes and into our subdivisions. And, as you heard all day, it's much better to prevent those fires or put the fires out when they're small, than it is to try to correct what a lot of us consider our prevention failures, when you're in a conflagration situation. There's an opportunity to inform the public and the developers of the needs that we in the fire service need to protect homes and to protect the wildland at the same time. And there's an opportunity to plan ahead. So, from a purely pragmatic view point, the bottom line is when you get into those public hearings and point

out that the public will not be protected and lives can be lost and homes destroyed because simple practices, which are considered routine by many of you, are not provided, the public officials have a hard time not going along.

Through the hearing process, through public awareness, and through working with developers, this can be done. We are not going to handle the interface problem by buying more fire engines and hiring more firemen. We are going to have to have the public and the politicians join with the fire service and with the land developers and the ultimate user, the homeowner, so that we can make it a joint project that we can all afford. Otherwise, we'll never do it and will be talking about it just like we are 10 years from now.

REMARKS BY JOHN JACKSON

You've been hearing a lot of comments about the value of local interagency cooperation, and I would like to share with you some key concepts that have fallen out, or developed, if you will, out of our interface experience in central Oregon. These are concepts that we feel have been an intergral part of what has been the beginnings of a successful risk and hazard management program in the interface area.

I want to talk just a little bit about some of the mitigating sides of things. You've been hearing a lot of discussion using that term today. I'm going to speak based on a frame of reference of experience from the central Oregon Fire Prevention Coop, and also more recently from the Deschutes County task force. A good example of this speaking with one voice occurred last winter. Several homeowner groups in an area south of Bend, which is in central Oregon, literally kicked our door down and were speaking with a single voice rather pointedly. When they got done with us they then went in and started talking to the County Commissioners with about the same type of an attitude. By the time we got it all put together, we found that we had something happening that was being motivated by an epidemic level of mountain pine beetle-killed lodgepole pine. We had been trying for 10 years to motivate people to want to do something to help themselves. The thrust of their speaking in a single voice was "get out of our road, because if you don't help us solve this problem, we're going to do it ourselves, and we really don't care about the consequences." And so, all of a sudden, the County Commissioners, the State Forestry Department, the U.S. Forest Service, the Bureau of Land Management, the Red Cross, and everybody else involved decided we had better get our act together because we are going to get trampled if we didn't.

One of the points that I want to make is that the scope of this interface problem is expanding. It is here to stay, and it is not going to go away. We have heard that, or heard variations of that all day, but that's the bottom line. It's not going to go away. Recall, for example, when we talked about land use planning and the role that it can provide or play in this situation. That's great for new developments. But what about everything that's already out there in the brush? What about the houses that are already burning up with wildland fire situations? What about those that are going to be built before we can get adequate land use planning procedures in place, for those of us who don't have those at the present time?

Consider a couple of points. On one hand we are not dealing with any new ignition sources. We are dealing with this interface problem with people, with their recreation, both at home and out-of-doors, their appliances, everything from automobiles to woodstoves, and all their other activities. We are dealing with people and their fire-starting propensities. It's not different from any urban or city situation. On the other hand, we have heavy wildland fuels or vegetation, often highly flammable for at least a part of the growing season, perhaps for most of it in many places. It's this combination that is starting to give us the problem.

Our ignition prevention programs, our loss control programs, structural fire safety fire approaches, and so on, developed over the years are still valid. One of the things we talk about, especially in the structural side of the fire services, is code. Is something going to meet code? Those codes are designed to protect structures, to keep them from catching fire. If they do catch fire, to mitigate some losses, and so on. But what about the brush? We don't have any codes for wildland fuels. We need some. Because if you're going to stick a house out there in wildland fuels, that's no different than having a lot in the city or a house in the city with dry grass two feet tall and brush and junk and everything else scattered all around. And yet, if it was in a city, what would we do? We would go out there and do something about getting rid of that hazard. We are not doing anything about that in the wildland areas in many cases. If you haven't guessed it by now, one of my real interests is fuels modification or landscaping in these subdivisions. The point I want to make here is that we need to expand our concept of prevention to include large or catastrophic fire prevention. If we are committed to protecting people and homes in this type of an interface setting, we are going to have to devise some methods to insulate them from wildland fuel hazards. Chief LaBlanc talked about some of the requirements that they are utilizing. It doesn't really make any difference whether we are talking hazard reduction or whether we use the term fuel modification or landscaping. We have got to get some of that wildland fuel into code, if you want to use that terminology.

One of the definitions of the interface has been the loss of a clear distinction between urban, rural, and wildland fire protection. If you are not aware of it, you need to be aware of it. Wildland firefighting techniques are having just as much problem with this interface fire situation as are structural firefighting techniques. It was mentioned earlier today that we do not have some of the liberties to back off a quarter mile and

put in a five-blade cat line and touch 'er off when you've got a subdivision in the way. That just isn't one of the choices any more. Fighting wildland fires is getting to be no big deal. It is dealing with that interface problem. How do you protect those houses and that value at risk stuck out there in the woods?

Among the solutions that are being considered is cross-training. Another solution that we have been doing quite a bit of is incidence response drills where all the agencies go out, pick a target area, and go through the motions. We exercise our incident management skills and at the same time do what we can to pump up the public and increase their awareness of the fire prevention situation.

There are more and more instances of fire control cat lines and various other wildland fire techniques being built right under the gutters of interface homes. And the growing magnitude of this situation is well documented by the 'Structures Threatened' list that many of us get from the daily situation report. I started keeping track of statistics but gave up after a couple of months because it became somewhat self-evident that I was not going to have any trouble coming up with enough examples to substantiate my point.

One of the especially valuable things that local government can do is to be prepared to let local homeowner groups do things to help themselves. We need to be sure that government agencies and government entities are not part of the problem instead of helping to come up with an answer to the problem.

As I mentioned, in this mountain pine beetle situation we are dealing with, we have an all-agency group, concentrating on one or two local homeowner associations at a time, cutting red tape. We go in, we meet with them, and we deal with the problems and questions they come up with. Having the chairman of the County Commission and representatives of all the fire services plus the Red Cross in the same room at the same time, assures that the homeowners get answers to all their questions. We have adopted the attitude that that is what it's going to take for them to be convinced that we, as agencies, really care and we really have their best interests at heart. So, consequently, they develop a perception of instant or immediate action in dealing with their questions and their problems. I think that there is a need to demonstrate this type of multi-agency coordination in presuppression and preparedness planning as well as suppression. We usually fight the fire pretty well together. We need to be demonstrating that same concept in a presuppression or preparedness planning mode.

The final point that I would make is that a multi-agency, multi-resource approach to dealing with this interface problem, is really critical to avoiding tunnel vision. You get a multi-disciplinary tenor to your solutions and it really helps to ensure that we don't get off into a blind alley or a dead-end in some our efforts. And we maintain good credibility with the folks we're working with.

REMARKS BY PETER KENNEY

I owe it to my County to clarify some of my earlier comments, just slightly. In the first place, we now know where to send Commissioner Levengood's rednecks. The reason that I want to say a couple more words about my County is that there is a part of this problem that we haven't really spoken about. And it's going to be the case in many other counties besides my own. Also in Clear Creek County, we have adopted the State Forest Service wildfire/hazard area concept. We apply it in every zoning case. We apply it in every subdivision. We even apply it in every subdivision exemption, which is a little trick of the Colorado statute that creates an abbreviated process for dividing land. We do apply those whether it's in access, certainly mitigation, thinning, and we cooperate, in fact, just like Summit County. We require the developer to go to the State Forest Service in order to develop a mitigation plan. We limit development in fire chimney's and on steep slopes. But the problem that we have is that all of these wonderful new regulations and opportunities and the new awareness that leads us to begin to apply them, the new support that we have from the excellent resource in the Colorado Forest Service, is all very recent. I have been involved in Clear Creek County's land use process since 1976 when I was a member of the County's Planning Commission and up to this point as a County Commissioner. And it's only been for about half that period of time that we have really had any significant effort to try to address this problem. Prior to 1973, we didn't even have any subdivision review. It just took place. Prior to 1964, there was no zoning. We have many communities in my county that were built prior to 1964 where the densities are eighth-acre lots out in the forest with no water, no sewer, no roads, but individuals own those lots, and they want to develop them. We have subdivisions that were put on the map, the plats were filed, and they are legal subdivisions that predate any opportunity for local government to comment, much less to regulate. And I think that we have a bigger problem in many areas, not with the future--we're dealing with the present and with the future in a much better way than we ever have before--but we need a way to go back and to retrofit some communities that we have out there that were built without any awareness that there was a problem, or certainly without any care.

And that reminds me of some comments that have been made. Enabling legislation is weak, was one of the comments that Lou Jekel made. And I'll give you an example of that. Two years ago the Colorado Legislature for some unknown reason--I haven't been able to figure it out--removed from the law the opportunity for counties to adopt fire code if their population was below 15,000. That takes half of the counties of Colorado out of the business of fire code enforcement. We need better

enabling legislation in that area. We need better enabling legislation in retrofitting, as I said, some of these communities for fire protection.

The reason that I bring this up, and I feel that it's important, is we've also had some discussion about public participation. I've been an elected official in Colorado, first as a mayor, now as a County Commissioner, for 13 years. I have been to a couple million public hearings. It's been my experience that 99 percent of the time when you go to a public hearing, and you receive public input, the people that you will see there and that you will hear from are those people who are opposed to something. The people who support a thought, an idea, a movement, a new awareness, and some better fire protection at the wildland/urban interface, don't come to those public hearings very often. And as one person with a very sincere special interest in favor of fire protection that goes back many years, I need the help of the other special interest groups and the public at large as they become more aware. I need them sitting in front of my table, telling me to go ahead and have strict regulations, have good enforcement and protect the resource, whether it's the human resource, private property resource, or our natural resources.

QUESTION AND ANSWER SESSION

Question by Greg Houley: I'm from Woodland Park, Colorado. I have two questions, the first for Chief LaBlanc and Mr. Jekel. Have you found that your regulations have stopped or depressed development in your jurisdictions?

Answer by Gene LaBlanc: Speaking for our area, no, it has not.

Answer by Lou Jekel: Very simply, what has happened is that the quality of building gets better, and when the quality of building gets better, you can charge more for it. People will pay more for it, and we find that Scottsdale has maintained, for instance, a building pattern--not a boom--but a good, steady building pattern when other areas become more depressed. So I think quality always sells. It doesn't have to be rich and fancy quality, but quality sells. And I think that these codes and all these, everything we're talking about, is on the quality side and that helps sales.

Answer by Rich Levengood: We're finding that in Summit County, also. There's an awareness, there's a tendency towards enlightened self-interest, and I think the better the quality, the more people sell.

Question by Gene Houley: My second question is for you, Mr. Levengood. Do you have written intergovernmental agreements between the county and the fire districts within your county in relation to subdivision adoption and building permits?

Answer by Rich Levengood: Not that I know of. I think this is something we should do, that's one of the things we've got to go back and do. There may be some. We have seven fire districts, and as I said previously, it's rather uneven in the way districts participate in the land use process. It's very good in my area, but it isn't very good in some of the other areas. And they do have a fire authority that they formed through intergovernmental agreement. I would like to see them revitalize or get that issue before them so we have an even response by the fire districts and then, in turn, we will enter into an agreement with the fire authorities, rather than the individual districts. I think it would work a lot better since we have seven districts. We haven't had much luck in consolidating districts. We've been defeated last year a couple of times.

Question by Steve Laursen: I'm with the Extension Forests here in Montana and I was going to ask you whether you were having a problem with homeowners complaining about increased costs for new homes. But I think you answered the question, that they seem to appreciate the higher quality. So I'll switch to another question, and that is, in your areas where your developments already exist and there are major problems with ladder fuels and so on and so forth, and no fire breaks and road problems, etc., etc., what have you done in order to get to those homeowners? There you are talking about an increased cost, you are talking about homeowners who probably figure the probability of them running into a problem is very low. What type of programs have you used in those established developments?

Answer by Peter Kenney: Well, I'll speak for Clear Creek County and very humbly say, we have done nothing. We don't feel that we have had any authority. We've been able to do nothing as a regulatory agency, let me say that. We have tried to educate the communities. Our fire departments, and in Clear Creek County, we have kind of a unique situation. We have two districts, or fire departments. We have four municipal fire departments. We have one private, non-profit volunteer company. And yet, although the jurisdictions were very shaky, very difficult to define whose jurisdiction was what, over the past seven years, those fire departments have come together, organized the Clear Creek County Fire Commission, which was mentioned earlier, and everything from border to border in Clear Creek County has an automatic response plan. What we have done is go into those communities, meet with the homeowners' associations, try to describe for them the problems and solutions that might be available. We have had voluntary cooperation in some of those communities to try to correct some of the problems. Many of those communities are working with the State Forester in order to try to institute some forest management. Primarily, that was in response to disease, unfortunately, both to the pine beetle and the spruce budworm, which are very serious problems in my county. But there has been some response from within those communities but it's been voluntary and there's been very

little that the government has felt they had any authority they could do.

Answer by Rich Levengood: We've done two things. We have contributed, out of the County General Fund, money for pine beetle abatement, and I think this year it was something like $10,000. That's helped. Another thing we have done, which is really politically loaded, is we've created, since I've been Commissioner in the last 2½ years, three local improvement districts. And access and water are paid for by the residents when you create a local improvement district. We've done that through commissioner initiatives rather than citizen initiative. We see the enemy and I guess he's us, and we took the rap on the knuckles and ran with it and created them, because we wanted to correct road problems particularly. One of them was very controversial about a year ago. It was defeated 2 to 1. I voted against it because it was not comprehensive enough to suit me. We just looked at one district and we needed to look at about 10 others. So that's an issue that's still going to be coming to the fore in Summit County.

Answer by Lou Jekel: I think that one area that has not been used is the improvement districts. We have talked about that in Scottsdale in downtown Old Town to put together improvement districts to resprinkle entire blocks of buildings. We haven't quite gotten that done. I think, though, there is great potential in going back to homeowners, at least in Arizona and I think probably in some other states, you can use 10-year tax-free bond money to do improvement districts. And, it may take enabling legislation, but I think something that should be pursued is to go to the homeowners, and say "OK, it costs this much to put in hydrants and it costs this much to put in road. We can get that done and pay for it over 10 years in monthly assessments like taxes." And if you can get their approval, or 51 percent in Arizona, you can go ahead with it. That's something that has not been done much and I think is really an answer to doing the retrofitting that Peter Kenney is talking about.

Question by Steve Laursen: I have a question for Ann Mary. Knowing the process of the master plan and zoning in Missoula County, you would think that we would make progress in trying to incorporate the fire type regulations and go through that process is Missoula County. Is there an avenue there for us?

Answer by Ann Mary Dussault: The experience that we had, when the Commissioners first adopted the Comprehensive Land Use Plan, in implementing it it was found that the zoning, the attempts to zone in all the rural areas failed. Plain and simple. I think that the methodology that we're using now is better in that we're going to those communities and they're developing their own plans and that, because they're doing that, we will see more quickly an acceptance of the implementation procedures because now they own the plan. It's not been something imposed on them.

Question by Ken Cassutt: I'm from New Mexico. I wanted to get back to the issue with the whole panel of increased developer costs. In New Mexico, we have our share of yuppies and marpies in Santa Fe and Albuquerque. But in the rest of the state, what we have are 'dumpies.' Those are downscaled, underhoused, multiple child parents. We end up with a lot of downscaled development in New Mexico. A lot of mobile home subdivisions where you put your mobile home there, you sink your own well, you put in your own septic system, and you're on your own. My question for you is, do you get complaints in your communities that those kinds of people are being pushed out by these increased regulations? And if so, how do you deal with those complaints?

Answer by Peter Kenney: Other than having them move to Clear Creek County? Who wants to take a crack at that? You've raised a good point.

Answer by Ann Mary Dussault: You've raised a good point. And I believe that the Montana Supreme Court has held that we cannot exclude mobile homes, for example, from any residential area, or at least those that were created before a certain date.

Answer by Peter Kenney: We have the same circumstance in Colorado only it's by statute, and not by case law, that adequate mobile homes must be allowed, cannot be prohibited by any zoning in the state. Nonetheless, the problem that you raise is very real that as a result, some of these communities do not adequately address the need for low cost housing. And it is a problem that we have to deal with. On the other hand, I see as a County Commissioner and looking at the statutes that govern my activities, that the primary function, the general description of the police powers of the board of commissioners in Colorado, is to protect and preserve the public safety, health and welfare. It's a problem. It's one that there isn't a good answer to, but as far as my own interpretation of my responsibility, I don't have a mandate to provide unsafe housing for any population.

Answer by Rich Levengood: We have our building officials and our life-safety people in the county work very, very closely with mobile home people, mobile home areas that may be out of compliance to bring them into compliance. We've adopted a stance, as a policy matter, in Summit County, that we were not going to deliberately drive out anybody by virtue of our standards in that county. So, we really go out of our way to work with folks, even old mining cabins. If we can make them safe--they've got to meet life-safety code, and it's worked pretty well. There's been general acceptance.

Question by Bill Barrigan: I'm from Washington. I think the dumpies are moving to Washington and central Oregon and northern Idaho in great numbers, and that really is leaving us with the meat of a problem that we've got in all of these states of the people that are going out in our

areas, and we don't even have rural fire protection for those people. We've had problems in our state of Washington. I visited the great state of Oregon and saw the same problems down there where you're putting $100,000 vehicles, fire apparatus, up to the end of roads, and being met by that gentleman with the 30-30 permit that has built a $5,000 dumpie. Then, as a County Commissioner, I guess my question is, how can you justify putting your $100,000 fire apparatus and people in a position of protecting structures of that value that aren't involved in any development process? They're not in a development with a developer. They've got a 20 acre patch and a $5,000 house, and that is all they own. And how can we ethically say we aren't going to protect them? They aren't paying for protection. But how can we ethically pull out and say, "No, if you want to come in and meet our standards, then we'll come protect you." That's what we're running into in the fire services is how do the state agencies and the rurals justify the expense? And it's coming back, saying County Commissioners, what are you going to do about at?

Answer by Peter Kenney: Well, I guess the essential problem that we're talking about today is that if we withdraw protection from that, or that one persons problem is not his problem alone. It's the nature of the wildland/urban interface that a wildland fire, from whatever cause in that area, is going to spread ultimately, and threaten housing, and residential areas. By the same token, if that person's home or hovel catches fire in the wildland, ultimately that fire spreads and threatens other natural human resources. So, I don't think there is any way that we cannot provide for that person's fire protection. On the other hand, there is no way ethically that we can ignore the threat that an unsafe occupation in the wildland places on everyone else.

SESSION 3

Carol Rice, Moderator
Wildland Resource Management, Inc.
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INTRODUCTORY REMARKS - WORKING TOGETHER OR CAUTION: BORDER CROSSING

Carol L. Rice

Working together, or crossing boundaries, is an especially important aspect of fire management in the urban/wildland interface because by definition there are numerous borders, necessitating frequent involvement with colleagues outside one's own organization. The key to success is to make this border crossing second nature before it needs to be done in an emergency.

Land ownership patterns are often fragmented and fire protection boundaries convoluted. All levels of government - federal, state, and local - are likely to occur in the urban/wildland interface. There are boundaries between different agencies within each level of government and between the various levels. Boundaries - both jurisdictional and policy-wise - may need to be made less distinct to enhance our ability to work together toward fire safety.

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Another type of boundary exists between goverment and non-government entities. Increasingly, the vital role both the private sector and volunteer fire departments or services play in fire protection is being recognized. Integrating these services and products into fire protection systems represents a boundary that needs to be crossed in the urban/wildland arena.

Finally, perhaps the most elusive boundary is that frontier between the fire management services and the community they serve since the public doesn't know or care about differences in agency policy or jurisdiction.

Fire protection in the urban/wildland interface is a premiere challenge because of dangerous fuels, limited access, high values, etc. We need all the resources conceivably available, regardless of source. Making those resources - human or equipment - available is best done by working together and crossing borders or organizations.

Transcending boundaries isn't always easy. Many issues arise, including those of defining responsibility, coordination, turf battles, duplication of efforts, and communication. The papers in the following session squarely address these issues.

TURF BATTLES--HOW DO WE MINIMIZE THESE STRUGGLES IN EMERGENCY MANAGEMENT?

Dick Montague

Our problem today is that most of us, as managers in the emergency services field, have been brought up during a period of growth and expanded services. We really did not need to seriously consider cooperative relations with other departments or agencies during this period of growth and adequate budgets and were considered as successful managers. Departments were expected to, and thus only provided the essential services for their specific clients. We knew where each cooperator stood in their specific areas of responsibility and chose not to tread on their turf. The definition of cooperation was much different than the one we use today.

Today we are faced with shrinking budgets, an increased demand for multiple services in an "all risk" environment, and a public that is well versed in the state-of-the-art cooperative efforts being implemented around the country. We were never taught how to deal with cut-back management and the turf conflicts that are now appearing with so much more frequency.

What do I mean when I say "turf battles?" I mean those areas of responsibilities where two and often more departments/agencies provide similar services within a given area, except the jurisdictions and missions may be slightly different. A few examples are:

1. Wildland fire vs. structural fire protection.
2. Search and rescue operations. (Emergency service vs. fire departments.)
3. Arson investigations vs. fire prevention. (Sheriff vs. fire department.)
4. Ambulance services vs. emergency medical services. This may be private contractors vs. fire departments.
5. "All Risk" emergency responses, that is, floods, fire suppression, earthquakes, hurricanes, and civil disorders.

The fire services are often faced with providing similar services along common boundaries. Federal, State, County, and local fire departments may be faced with situations in which their neighbor is better financed and equipped, and has the capability to provide a higher level of service to the constituents. Most of the time salary scales and employee benefits may vary greatly between departments. This is usually the case in big city versus the smaller city or volunteer departments along common boundaries. Also, you may be put in competition for budgets, personnel ceilings, and equipment with other departments within your city, county, or state who are willing to provide these similar services at lesser costs. Usually the charters of these departments are quite similar in mission and the most aggressive leader comes out on top.

Fire service personnel cannot provide the excellence of management expected by those we serve if we don't take the initiative and strive toward providing more cooperative efforts between agencies with common responsibilities.

Does this conflict in turf jurisdiction still take place? It certainly does; I would like to mention a few occasions around the country this past summer where the principal jurisdictional agency refused assistance from their cooperators, then proceeded to lose control of their incident. One example was a situation in which one agency decided to send another agency home and then proceeded to lose a wildland fire that destroyed homes within the jurisdiction of the agency sent home. First of all, I question why the two or more responsible chiefs did not sit down together and develop a common strategy that would address the concerns and objectives of all agencies potentially involved. In this particular case, the agency responsible for sending the other agency home was not equipped, trained, or responsible for structural fire protection. They were well qualified in wildland fire protection and, at the time of decision, the fire was only burning on wildlands within their jurisdiction. The structure loss threat was in another fire protection jurisdiction located within the overall boundaries of the wildland fire agency's jurisdiction. The wildland fire agency underestimated their ability to contain the wildland fire within their area of responsibility. They did recognize the potential threat of multiple structure loss if the fire was not immediately contained; however, because the other agency was not trained or equipped for the wildland fire suppression mission being performed at the time, they were dismissed. Most of the time these issues of turf conflicts are not intentionally made to ignore the other agency. They are often made in the heat of the battle and

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by personnel not totally aware of the other agencies' responsibilities and concerns.

What can you do to prevent these situations occurring within your jurisdictions? You should volunteer to host a meeting of all your key cooperators and jointly develop an inventory on who has what personnel, skills, and equipment. Next, you should develop strategies on how to coordinate your efforts to use the closest qualified resources and/or shared resources on those incidents where you might exceed your own capabilities or where there is an overlap in responsibilities. Most important of all, decide to use the resources in the areas where they are best trained and offer the highest skill. A good example is in those urban/wildland interface areas where structural and wildland skills are required. For example, assign the structural fire units to the structural fire protection tasks and the wildland fire units to the missions for which they are best equipped and trained. Before you can effectively use these shared resources, you must:

1. Develop common standards and terminology.
2. Use a common emergency organization that all agencies understand and use every day.
3. Establish methods to reimburse each other for services rendered, and
4. Create an interagency decision-making process to direct the operational procedures to be followed.

There are many good examples, throughout the United States, where cooperative departments have gotten together and created an Oversite Group/Board of Directors' concept consisting of the top managers of all the emergency services departments having common responsibilities. These groups/boards can be a representation of multiple counties or be limited to department heads of one specific area or city. Experience has shown that we often start out limiting our concept to a small area and quickly find out that these same concerns can and should be expanded on a much wider scope. I am aware of some very successful Oversite Groups/Boards that:

1. are State-wide in scope.
2. consist of several Federal and State agencies, a large metropolitan city, and four large complex counties, and
3. involve two States, three federal agencies, and multiple county, city, and local emergency services agencies.

There are no set answers on how large or small the Oversite Groups need to be for effectiveness.

The principal key for success in the aforementioned models was the fact that agency top managers got together as an interagency group to both individually and collectively support the creation of an effective decision making process. These interagency decision-making groups took on the responsibility for overseeing the general interagency cooperative operating procedures. The size, membership, and structure of the decision process group was tailored to meet each specific area's need. Members had the delegated authority to implement these jointly prepared procedures within their own specific agency. The decision-making group provided the interagency direction to subordinate interagency supporting committees consisting of technical experts specializing in their specific functions. Some examples of these supporting committees are:

1. Safety and training
2. Communications
3. Systems and computers
4. Hazardous materials
5. Specialized fire equipment
6. Standards and qualifications

The supporting committee's role was to recommend the operational procedures, standards, and certification for performance criteria in their specific area to the oversite group for adoption by all participating agencies. In most cases, the oversite group established an interagency coordination center. When resource needs exceeded any one agency's capabilities, this center would then become operational and provide a single point ordering source with authority to set priorities and screen duplication of orders. This type of coordination center may be a 24-hour operation or it may be activated with trained specialists upon demand. Representatives to these coordination centers must have delegated authority to make agency decisions on whether resources can or cannot be obligated to a single incident or multiple incidents.

The establishment of preplanned interagency incident management teams was another successful factor in the cooperative efforts found between these agencies. The oversite group established common qualification and skill standards and selected the participants for these interagency teams.

Interagency incident management teams should consist of representatives from all participating agencies. Occasionally, the leadership (incident commander and/or operations section chief) roles may change based upon the type of incident, for example, sheriff in law enforcement, search and rescue incidents, and fire chief in fire and medical assistance missions. The principal support section chiefs of planning, logistics, and finance would remain constant. Incident information and safety staff would also remain the same on the team.

Another approach is to use the unified command concept of multiple incident commanders working together to set the incident objectives and then select one operations section chief to implement a plan to meet these objectives.

It is a well-known and accepted fact that personnel who train together, use common terminology, have joint or co-located dispatch centers, and share the closest available resources, are providing their taxpayers with the most cost efficient and effective form of emergency services.

The reason I surfaced the aforementioned methods of cooperation is the fact that these state-wide and local area cooperative efforts have and will continue to be the focal points for other wildland/urban interface efforts. This is especially important in those areas where a united front by all is a "must." One that comes to mind is in fire-safe guides for living in a wildland/urban interface area. Others will talk more about this subject later in the program.

Throughout the country we have had several examples of "turf battles" that made front page headlines in the newspapers or television programs. In almost all cases, the participating fire departments came out with a "black eye." I am concerned that the images of the fire services are maintained, but I am much more concerned that the real issue of what is required for the private citizen to live safely in the wildland/urban interface area was lost in the smoke by the media covering only the issue of "feuding fire chiefs." Public hearings that surfaced after these fires focused on improved cooperative relations, who improperly used the resources available to them, and really did not address the real issue on how to "SURVIVE A FIRE IN THE WILDLAND/URBAN INTERFACE."

How well are you and your cooperators doing in this cooperative work?

PRIVATE ENTERPRISE AND FIRE PROTECTION SERVICES: A LOOK TO THE FUTURE

Louis G. Jekel

ABSTRACT: Contracting fire protection has been with us for a long time. Now more and more private contractors are entering the marketplace. Economics dictate that new ways be developed to address the ever-increasing costs of fire protection. This is particularly true of smaller resource units with lower overall fire danger. Contracting all elements of the wildland fire protection program can be another tool available to the land manager.

INTRODUCTION

Contracting wildland fire protection has been commonplace for many years. What is new is that now some of the contractors are private corporations. Private fire departments sprang up in many parts of the United States after World War II when war surplus fire equipment was plentiful and relatively cheap. These fire departments were rural in nature and although they began primarily as structural fire departments, over the years as the urban dweller moved to suburban and rural areas, these fire departments found themselves more and more part of the wildland fire protection system.

Historically, many components of the Nation's wildland fire protection system have been supplied by private independent contractors. Catering, aviation, transportation, earth-moving equipment, emergency medical services all have from time to time been supplied by private industry. The move to actually contracting suppression services is a logical extension of the cooperative effort private enterprise has played in the past.

OVERVIEW OF RURAL/METRO CORPORATION

Rural/Metro Corporation was founded in 1948, in the unincorporated suburbs of Phoenix, Arizona. Since that time it has grown in size to an operation involving some 1,800 employees in five states, providing a full range of fire protection, suppression and emergency medical services.

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Rural/Metro provides contract fire protection and suppression services to numerous cities, fire districts and unincorporated areas within the States of Arizona and Tennessee. It provides ambulance service in Arizona, New Mexico, Texas, Tennessee and Florida. Rural/Metro has provided wildland fire protection services to the United States Forest Service, the Bureau of Land Management, Bureau of Indian Affairs, National Park Service and the State of Arizona.

All full-time Rural/Metro fire fighters are certified basic emergency medical technicians, with many of them certified paramedics level. Because Rural/Metro has historically been a rural-oriented operation, it has always operated between metropolitan population centers and the wildlands. Of all structural fire agencies in Arizona, Rural/Metro has the greatest wildland urban interface exposure; primarily in the Tucson/Pima County area and the Phoenix/Maricopa County area.

BUDGETS NECESSITATE NEW APPROACHES

An analysis of the inner-workings of a major wildland fire organization will show many segments of that system that either are already contracted out, or very well could be. The question, therefore, is why is it just now that private enterprise is beginning to participate more actively in the wildland fire protection system? The two primary reasons probably are budget and acceptance.

Over the years the budget constraints on wildland fire organizations have grown to the point where managers and administrators must find alternatives to the conventional and sometimes expensive creation of separate fire organizations. Acceptance, on the other hand, has been gained by companies like Rural/Metro who have been in the business long enough and who have patterned their training and incident command procedures after those developed by the governmental wildland fire organizations. What really makes contracting attractive to the government fire manager who has a problem to solve, is the flexibility that a wildland fire organization can provide.

In studying the major fire organizations throughout the United States, be it the fire department of New York City or the United States Forest Service, one sees that where fire occurrence,

risk and exposure is the greatest, it is clearly the easiest to provide a strong and economically justifiable fire organization. Where the real problem is, and where private contracting is more and more seen as the answer, are those areas having shorter periods of less intense fire activity on a sporadic basis. There are many land management units within the United States that have either very little fire problem or have fire seasons of very short duration, with intensities that vary greatly from year to year. These land management units are ripe candidates for contract fire fighting.

The new module that will appear will be a full-service, "portable" fire department. The portable fire department will be a total fire protection, prevention and suppression module, that can be moved from area to area on a predetermined schedule. Flexibility permits, during those rare years that a low fire danger area experiences high fire danger and the season becomes elongated, the operation to stay in place on a week-to-week or month-to-month basis until the fire danger drops and the fire department moves on.

The cost savings in not having to support a 12-month fire program to deal with a two-month fire season will be astronomical. This need not be a threat to land management units having fire organizations who will then be freed up to handle more serious fire problems. A transitory contract system can maintain continuity of people who are in the fire protection business on a full-time annual basis, only in different locations. The fire prevention program and overall fire management goals of a contract would be administered as in the past by the receiving agency, but a highly mobile, well-trained, well-equipped fire suppression organization would move in, set up, do the job and move out at great cost savings to the public.

CONCLUSION

In final analysis, private fire organizations become just another tool for the fire manager in doing the job. Cost effectiveness will be the watch word and will make it very desirable for the public and private sectors to continue to enlarge their already existing partnership.

GAINING COMMUNITY AND PUBLIC SUPPORT TO SOLVE THE WILDLAND RESIDENTIAL FIRE PROBLEM: A PANEL DISCUSSION

Bob Lee, Gary Severson, and Ron Hodgson

REMARKS BY BOB LEE

My remarks are designed to provoke you a bit, perhaps to anger some of you, and I have departed substantially from my prepared remarks in order to discuss the topic of who is ultimately responsible for solving this interface wildfire problem.

What worries me is that I think we are searching for some new technological fixes - new fantasies, if you will. Our response to the interface fire problem may turn out to be as counterproductive as was our attempt to exclude fire from natural ecosystems in the temperate regions. We may be just as irrational and just as fanciful in our thinking as were the people who set out to tame the fire demon. I was quite surprised when I came in yesterday and saw the dragon slayers poster paper - saving the damsels from distress. At the University of Washington, we're teaching our young women to practice assertiveness tactics and to take responsibility for their own lives. It's the age of the new woman where the woman doesn't need the knight to protect her from the dragons, and I would suggest that perhaps it's also the age of new fire management where responsibilities are allocated a bit differently than they have been in the past. The age of chivalry is past. It's too expensive, it doesn't work very well. I would suggest that a lot of our current fire management practices, fire suppression practices, are equally outdated.

We have to ask the question, who is responsible for solving this problem, and who pays? Our failure to define these responsibilities is at the very root of the problems we have been discussing here for the last day and a half. Better suppression, no matter how well it is organized, through all kinds of communications advances, is insufficient and is potentially counterproductive. Let me repeat that. Better suppression is insufficient and potentially counterproductive. Why is that? Because it raises unrealistic expectations on the part of the public that we, wildland fire agencies holding hands with local protection districts, can save your home. We all know we can't do that. We can't stop all these fires, and in the process, we are losing enormous amounts of wildland resources in watershed, timber, wildlife values, wilderness values, and other resources in wildland settings. There are some analogies to this, in the kind of irrational approach that we take to trying to solve some of our problems in modern society. Flood control is one. We built dams and said, we now can control the flow of rivers. So what did the people do? People moved down closer to the river in the flood plain. And so it resulted in more people getting flooded out than had ever happened before because people thought that now that there is a dam upstream, there won't be the ravages of floods that we've seen in the past.

In our cities, we've espoused a very idealistic, and well-motivated objective of integrating the races. We've said "we'll put them together in schools by busing them." What have we done? We have produced residential segregation where the inner cities are now dominately ethnic and poor and the suburbs are wealthy, middle-class, and white.

And so we haven't looked at the unanticipated consequences of many of our policies. These policies have been misguided and irrational because they haven't taken into account that people respond to what we do. They are part of the problem, and they are ultimately the solution.

Let me take just a few minutes to talk about some experiences that were quite poignant for me this summer. As a forestry student, I worked on California's Mendocino National Forest, in the county where I grew up. All of the silviculture I did then has burned up during the last month and a half. In fact, there is very little actual forest left on the Mendocino National Forest. You look at the rest of that county, Lake County, California, for example, is similarly burned over. In the 35 years that I've been recording these kinds of experiences in my head, gathering these impressions, I've seen the steady degradation of the forests of that county, the conversion of

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Gary Severson is President, Dynamic Horizons, Evergreen, CO.

Ron Hodgson is a Professor, California State University, Chico, CA.

forest to brushland and grass. There's something wrong with our fire policies.

What are the failures here? One of them is that we have failed to understand the role of fires in temperate forests and, by excluding fire, have produced conditions where fires are even more destructive, and those 200 and 300 year old trees that I knew as a child are now dead. How did they persist there for 200 or 300 years in the presence of fire? They persisted because fires were frequent and had burned periodically through the forest, taking out the undergrowth but not killing, or very seldom killing the overstory trees. That's one lesson we've learned and hopefully we're trying to correct.

But I think we're now facing the same problem in another way and with just as irrational a response, in the interface fire problem. We're allocating our fire suppression forces to protecting homes at state or federal expense, very largely, we are then leaving the rest of the forest to burn. And a good part of what has happened in the county I came from, in losses to the forest land base, is a direct result of a diversion of fire suppression forces from protecting the land to protecting homes; homes that were built there by people who simply didn't realize what they were getting into.

We have compounded the losses through fire exclusion, and we have further accelerated these losses by not allocating responsibility to where it belongs with rural residents. What is the solution to this problem? It's very simple. If you look at our legal system and what we have done historically in this country, people who build a home in a rural area are responsible for the costs of fire protection. Yet we find federal and state wildland fire protection agencies increasingly picking up the costs of playing the knightly role of saving the damsel in distress. The action that's required to solve this problem is the mobilization of these people and reallocation of responsibilities. I realize that's a very impractical statement. But I think someone's going to have to start looking at it rather seriously.

Local fire districts are going to have to be formed and the people who live there are going to have to pay the true costs of fire protection. They're going to have to similarly undertake those loss reduction tactics we've been talking about here. Look at the tradition of ranching communities in the West. They didn't have federal and state fire suppression forces. And they learned how to treat hazardous fuels, they learned how to burn around their barns and their fences and their homes, to use plows to create fire breaks to reduce risks, and I think those same survival tactics will have to be learned by the people who live in the rural sector.

There's also some very theoretical reasons why we can't solve these problems, because if we take it on as our responsibility, whether we're researchers, teachers, fire department officials, foresters, we can't know enough about the problems to engage in rational planning. We simply cannot do it from the top down. Knowledge is socially distributed throughout society. We need to mobilize that knowledge to people who live there with those problems, and we cannot coordinate all of those independent initiatives out there, all of those people doing all those different things. They have to do that on their own. The only motive they're going to have is the knowledge that they're ultimately responsible for protecting their structures. They have to build fire districts, tax themselves, and provide the services that are appropriate.

In conclusion, I'd simply like to say that we have to look very carefully at our policies to make sure we don't create unrealistic expectations. We can get ourselves into serious legal trouble by telling people now that we have NIMS and ICS, and all these good things, that we can protect your home. That's not true. We simply cannot make that claim. I think we have to be honest with people and tell them, "you have the major responsibilities for protecting your structure. Our responsibility as wildland protection agencies is to protect the forest resources. We will help where we can in making sure that fires don't burn into urban areas or into rural residences, but we cannot always be successful." And with this reallocation of responsibility, people will begin to undertake, to adopt, some of these practices that we've been talking so much about here at this conference. So I'd encourage you to look at that and to examine legal and political mechanisms by which this kind of redistribution of responsibility can take place. It's consistent with American legal traditions, it's consistent with decentralization, and it's the only way in which we'll ultimately solve the problem.

REMARKS BY GARY SEVERSON

My experience includes working in the area of public participation, and working in the areas of community and acceptance and resolution of community issues over some extremely controversial issues. Finally, I come to you as a homeowner and Bob, you gave me a double whammy this morning. My home sits in a canyon with a major stream running right past the front of it and I've got a mixed stand of Douglas-fir, ponderosa pine and lodgepole that comes down into my back yard. And I do have a shake shingle roof.

The situation that we live in in my particular community is very interesting. I'm going to relate this situation to, not the fire problem, but rather the flood problem in talking about how we might be able to work better with communities and get people to understand exactly what's happening out there.

My particular community, Evergreen, Colorado, is part of Jefferson County, Colorado. About half of the county is plains, about half is mountains. The bulk of the population lives on the plains. We have three County Commissioners, two of which

represent areas on the plains, one of which represents those of us living up in the hills. The Federal Emergency Management Administration (FEMA) basically told our county that you, Jefferson County, you're either in the program, or you're out of the program, when it comes to flood insurance. It's either all or nothing. And, boy, it immediately put the County Commissioners right on the spot. The studies that were used to calculate where the flood plains and the maps that were drawn, were less than sufficient. The maps were drawn at such a scale, using a broad tipped felt marker, that you couldn't tell whether your property was in or out of the flood plain. If adopted, the program cost was to be borne by you if you wanted to find out for sure, the data that was used was from an entirely different drainage whatsoever--the Big Thompson drainage, not the Bear Creek drainage. And I'm sure most of you have heard about the Big Thompson flood, an entirely different geologic structure than our particular canyon; it drains the Continental Divide, ours doesn't, and so on and so on. And yet, they used that model, and a "National Model" to make decisions for those of us who are living right there.

The big problem that FEMA made was that they didn't take the time to find out what was important to the people. Yeah, it's easy to say protecting your homes and protecting lives from flood and so on is extremely important, that you folks up there, living in that canyon, you've got a problem. But you see, the people living in that canyon, my neighbors and myself, we didn't think we had a problem. And so, when someone comes in and says "you've got a problem and you need to do something about it," and if the people living there don't even think they've got a problem to begin with, you're not even to first base. And the communication is totally blocked at that particular point. We had the evidence to show that we didn't have a problem. There had been no historical evidence of a flood in that canyon whatsoever. One of my neighbors owns a geologic consulting firm. He had his firm come up and take all kinds of core samples. They found lots of glacially deposited soils but no water deposited soils whatsoever in that particular canyon. And yet FEMA didn't want to look at any of that data. They didn't become familiar with our community. They didn't become familiar with our goals and our objectives. They didn't become familiar with the fiscal realities of our particular community. They weren't aware of the social and cultural uniquenesses of my particular community, or its history or experience or the geographic relationships that we have that are very unique within that county. It was folks putting the County Commissioners on the spot - it's all or nothing. Either the entire county is in the program or the entire county is out of the program. In short, they didn't really do a perception of need, and therein was the problem.

The second thing that happened there was that all choice was taken away. And I'm sure that Ron and Bob both could talk about this phenomenon of choice. Choice is extremely important to the individual. Peter Kenney, a County Commissioner for our neighboring county, talked about the people in Clear Creek County being rugged individualists. Well, we're all rugged individualists, because we all want to preserve choice in our lives as much as we possibly can. It's extremely important to all of us that we have choice. Henry Ford once said that you can have any color car you want as long as it's black. And it used to be that you could have any color fire engine you wanted as long as it was red. And I'm glad to see that maybe now there's some white ones and some chartreuse ones and who knows what other colors are coming out out there. But choice is extremely important, and whenever there's any kind of a program change that needs to take place, choice has to be a very important part of that. FEMA gave no choice - it was all or nothing - one or the other - no choice.

The perception of choice that an individual has directly relates, then, to how much constructive communication there is going to be. And if that individual feels that there is a wide range of choice in helping to shape the program that is eventually going to come out, there will be a great deal of constructive communication taking place. And I think we'll find that the collective wisdom isn't in Washington, DC, but it's clear across the nation. And there's as much wisdom in Evergreen, Colorado, in particular on upper Bear Creek Road (that's where I live), about the area that we live in and, in particular, about the things that affect our lives, as there is with agency administrators in Washington, DC. And we have good ideas at our level, too. Ones that we can live with because we're the ones who eventually end up living with it.

So this whole business of choice is extremely important. And I would hate to see a program, and I don't think it's the intent here, for any wildland/urban interface fire program of whatever kind, that would become a national program directed from national levels and given to or directed to local areas with no choice on their parts whatsoever. I don't think that's what you want, and speaking as a homeowner in this particular case, it's certainly not something that I want. It just won't work. Not in 1987.

Choice has to be meaningful and real. Our volunteer fire department in Evergreen is one of the finest volunteer fire departments around. And they do a lot of training of the volunteer fire department members. Our fire chief has taken it upon himself this summer, as result of last year's conference in Denver, to begin working with homeowners and allowing them choice in determining what's important to them about protecting their property. He's not telling people they've got a problem. He's saying, "Hey, you've got a really wonderful opportunity to live where you live, and here are some suggestions that you might want to follow in helping to protect that investment and that lifestyle that you have chosen for yourself." All of us are involved in choice. It's extremely important. The key to choice is meaningful involvement, and then meaningful involvement of

the people is the exercise of that choice. And if you don't have it, you're not going to have a program that works. It's going to be just another bureaucratic program that we're trying to drive down people's throats, and that's the way we looked at the flood insurance program from FEMA.

The third thing that we have to look at, in working with communities, is convenience. You folks, especially here in the fire service, it's your life, it's what you do, it's the most important thing to you, it's your career, it's what you've chosen to do. An extremely hazardous choice, I might add, but you've chosen to do it. Well, that's not the same agenda of everybody else in the world. And so what may be convenient to you, in working through a fire program, or protecting homes and communities from fire, may not be convenient for other people. I've got a shake shingle roof. For me to strip all those shakes off of that house at this present time, and to replace it with some other type of roofing material, ain't convenient. Especially in my pocketbook. And we can sit here, and I can get on all kinds of guilt trips about my shake shingle roof, and I've heard a lot about that, but my fire insurance is paid up. And under the current situation, that's fine. And I'm doing some other things around the house. It's got to be convenient and people have to be able to have that choice of finding out, first of all, what they can do that's convenient to them. And I agree with Bob Lee wholeheartedly, that the responsibility for those of us who have chosen to live in those areas, must rest with those of us who do live there. But what are the things that we can do that are convenient and are within our realm of doing. That's what we need to know and that's what we need to find out.

The fourth thing, then, is a commitment - a commitment on the part of the fire services to work through this problem, this situation, and a commitment on the part of the homeowners and so on, to work with the fire agencies in doing something about it. The result of the FEMA situation in Colorado was that we organized so successfully there, we defeated the flood insurance program for Jefferson County by a vote of two to one from the County Commissioners. So, FEMA pulled out of the county. And now, the creative solutions begin to occur. The County, my homeowners association, my community, other emergency agencies within the county, are creatively working now for alternatives to the FEMA program. And I noticed just the other day that FEMA is now beginning to look at the fact that maybe Jefferson County is really two counties, and to look at the areas of the county below 7,000 feet and those above 7,000 feet as two separate programs. And now we're beginning to get some reasonable solutions discussed, coming primarily from the grassroots level.

If we want to do something with our interface fire program, we need to realize that it has to begin at the grassroots. You see, we can talk about the problems of homeowners all we want. But I know if I went to my homeowners association today and I said "Hey, we've got a problem with fire!", one of the first things they'd say is "well, I'll tell you what, I'm an adult, I made a choice to live here, I know what the risks are. And number two, there's a lot less risk in living up here than there is down in Denver. If you don't believe me, just go down and listen to all the police and fire and ambulance sirens going all night long, and you tell me where the safest place is to live." And until we can come to some kind of an agreement and not be paternalistic about it, but understanding that people have made a choice, and now how can we help them enhance that choice, then we will have a program that really does work at the grassroots.

REMARKS BY RON HODGSON

I'm coming to you as a fly-fisherman. I have some nomex but I always keep it well-washed and neatly pressed, and I always keep my whites greased and brushed, and I always wear my blue hardhat when I'm around a fire camp because I don't want anybody mistaking me for somebody who knows how to use a pulaski.

I'm a communicator. It's time to learn how to promote defensible space to people who live in the interface. I want to add to some of the things that have happened here. And maybe it's time to roll up our sleeves, take off our coats and look at some useful kinds of things we might do. How do we communicate with people out there? How do we deal with this situation?

The people we want to communicate with out there live with each other in neighborhoods. They're not scattered all over the place. We usually want to communicate with clusters of people who live in neighborhoods, and those neighborhoods usually are placed right in the fire hazard. Neighborhoods are made up of people who are linked to each other by interpersonal communication channels. What that means in English is that you talk to your neighbor about all kinds of things, and when something important comes up, you ask him, "do you think that's a good idea?" You may ask it directly or you may ask it indirectly, it depends on how concerned you are about whether you're going to look foolish or not.

People don't make important decisions by reading, watching, or listening to the mass media. People don't decide to tear off a shake roof and put on a metal roof, for example, or a composition roof, by seeing an ad in the newspaper or watching some program on television, even if it includes a lot of flames and smoke and excitement. When people make those kinds of decisions they check with their opinion leaders. There are one or two people in the community who may make their decisions based mostly on what they know from the mass media or people from outside the community; the rest depend to some degree on what opinion leaders feel. There may be people who are aware of fire and understand fire better than the average person in the community, and those people then, may be opinion leaders. Mass media alone isn't going to do it. The Smokey the Bear

campaign will keep people aware, but it's not going to get people to change their behavior. What changes peoples behavior is interpersonal communication with their friends and neighbors.

This is starting to look even worse, isn't it? First of all, we've got the problem that we're not doing the right thing because it's their thing, and they ought to be taking the responsibility; now we can't even use mass media to communicate. We've got to solve this problem somehow.

People aren't concerned about fire safety all the time. There are three parts to a fire at least. There's the before, the during, and the after. What people are concerned about before, during, and after a fire is quite different. A recent experience--we had a community that was threatened by a fire on two sides. The fire was moving a little more slowly on one side than on the other side, but it looked like this community was going to be gobbled up. The strike team in there went around the community and said, "this house we can save, that house we're not even going to go near." People asked "why not?" "Well, you haven't got a driveway big enough for an engine, in fact, you can't get a large automobile up it, and you've got no water, and you've got brush growing all around it, and so we can't do anything about it." This was in a public meeting, not one-on-one. Friends and neighbors were around. People said, "well, I guess you're right. I've got a whole drawerful of citations from the Forest Service Fire Prevention Technician that told me I was supposed to fix those things; so, OK, if it comes, that's it." They made a decision there. They had made a different decision before. See, your attitude may be a little different during the fire than it is before the fire. After the fire you've got a recovery situation. There are different stages in the fire experience that are going to make a difference in what kinds of messages people are going to want to pay attention to.

Also, people make rational choices more often than we imagine. Often people who are making those choices do some kind of a benefit/cost analysis whether its monetary or emotional. Sometimes they behave as they do because they don't know what's going on. Often, though, people are making decisions when they really know what is going on and they have looked at their alternatives. You've made choices to be firefighters; maybe you've gotten out of the firefighting part of it and stay around the fire camp like I do, but at least at one time, you made a decision to fight fire. That was a dangerous choice; people in their right minds would not choose that kind of an occupation. So, as long as I'm talking to all you crazies out there, I feel more at home. People who choose to live in a dangerous place may not be any crazier than we are.

People have an agenda, and we have an agenda, and their agenda and our agenda often are quite different. When we think of communication, typically we think of how to choose messages and choose media to get a message out to them to persuade them to do what we think that they ought to do for themselves. Since we're not them, we have a hard time making those kinds of choices. If we rationalize and optimize for ourselves from what we know and the kinds of values we have, we're probably not going to make the choices they would make. We won't choose the media they would and we won't tell them the kinds of things they would ask to know. On the other hand, when they communicate, they look for the kinds of things they think they should know, or want to know, from the people they trust, and from their favorite medium, whether its interpersonal or mass communication, so that they can better do what they want to do. Not so they can better do what we want them to do.

Now, there are two differences here. In one case, you think you're passing a message out to them to affect what they do about fire safety. And in the other case, they're looking at the situation and saying, "I've got all of these choices out there of media that I can pay attention to, I can watch television or listen to the radio, I can read newspapers, I've got hundreds of newspapers I can choose from, I can read magazines, I can talk to my friends and neighbors, I can walk down to the fire department and talk to them, I can check with universities, I can call my uncle in Santa Barbara and ask what he did when the fire came. I've got all kinds of alternatives, and whether I choose to listen to your message or not depends on lots of things, how I think what you have to say matches what I need or want to hear."

Does that mean that we can't communicate with them? No, not at all. We can communicate with them. Now this is where the hypodermic needle and the fly-fishing comes in. The idea that we seem to accept without even thinking about is that the mass media are like hypodermic needles. All we have to do is get the right hypodermic needle and the right solution, (the hypodermic needle is the medium), choose the right needle (a big one), and get the right solution in there, and then when you see an unsuspecting interface homeowner, inject it. Immediate, powerful impact! If we could just choose the right message, choose the right Smokey the Bear or Woodsey the Owl or whatever, we could get a message out there that would strongly impact the people, they'd change their ways, see the light, and become converted. They'd all move back into the cities and leave the wildlands alone!

You've heard some other images of the hypodermic needle. People have told you if you worked with the media, 'don't use the shotgun approach - use the rifle approach.' There's a kind of a hunting image to that. I prefer the fly-fishing model. If you are a fly-fisherman, you've studied fish behavior, and gotten up at inconvenient hours to stand in inconveniently cold water, and fished in places where you lose a lot of flies, and you do that because that's where the fish are, and that's when the fish want to eat. Then you "match the hatch"; you provide something that looks like what the fish are looking for. If you're skillful at it, you'll catch fish. Now, that's how you have to communicate. You have to match the hatch. That means you have to find out what their agenda

is, what their motives are, and put your message in that form. You must provide people with the kinds of messages they want, when they want them, and where they will look for them. They will pay attention to your message if it is attached to something they are looking for.

I want to go through a series of slides right now, very quickly, to show you how you would go about working that kind of a strategy, how you would match the hatch.

Slide 1: (Promoting wildfire safety among homeowners: A social network perspective.) I'm going to use that social network perspective, the fact that people are interlinked to each other, remembering now that they've got their own agenda, their own values, and their own motives.

Most decisions are not made all at once. The mass media doesn't hit you and you say, "Doggone, I'm going to go out and change that roof right now." You become aware of it first. The mass media is good for creating awareness. You become aware of the fact that you've got a problem. Then you go through a stage of persuasion. The mass media don't help you at all there. That's when you talk to your friends and neighbors and find out whether you're going to look dumb if you put a tin roof on your house. In some places, you would. You would no longer be invited to the bridge games. At the decision stage, you commit resources. Not only can you make up your mind that you're going to change your roofing material, but then you've got to figure out where you are going to get a loan to do that, when you are going to get the time, where you can find a contractor. All kinds of things have to happen at the decision stage. When you've committed those resources, you can move on to an implementation stage. This is when you actually get the work done or do it yourself. And finally, you've got to confirm that it was a good idea. A roof, if you get it changed, will probably stay on there. But brush clearing around the house will not, the brush will grow back, the grass will grow back. So every spring, you've got to go out and clear around your place. That confirmation stage has to be constant. People have to keep being reminded that, "it was a good idea to do this; it's still a good idea to do it; I should get out there and do it."

Slide 2: (Analysis) The first step is an analysis. At this stage, you have to find out what media are available--the mass media, and the interpersonal networks. Many communities don't have much mass media. When the newspaper comes out once a week, you can't rely on it entirely. You may have to create your own mass media which may be flyers or posters, or public meetings, or talks. Evaluate the interpersonal communication networks. Who talks to whom, who are the opinion leaders, who are the key communicators and the people in a position to get information out to other people and to influence their attitudes and values and beliefs.

Technology assessment: this is a pretty important step. Is clearing around houses consistent with homeowners' values or beliefs, or are you going to ruin something important to them by removing the brush? They may live in that environment, for example, because it offers a sense of prospect and refuge, which is a psychological description of the fact that people like to be where they can see out and still be surrounded and protected. Prospect and refuge may be one important environmental value that people will want to preserve in any firesafe program of landscape modification. There could be others. We need to know how our recommended clearing effects these values before we promote it. Maybe modifications can be made.

The assessment of firesafe "technology" should also take into account the degree to which people might see it as hard to understand or use. An idea that is too complex will not be adopted easily. If people think firesafe is too complex, we ought to try to make is simpler in their eyes.

People should be able to see the beneficial results of firesafe practices. Firesafe clearances are easy to see but they may seem ugly to people who have the kinds of values I speculated about before. The real benefits are hard to see unless a fire threatens. However, effective use of the mass media can overcome part of this problem. At least some people will be able to imagine their own situation if fire information officers are able to demonstrate the effectiveness of clearances to the press covering urban/wildland interface fires. We need better ways to make the benefits of adopting firesafe practices visible to people.

What are the advantages of firesafe clearances compared to the alternatives? This relates to the values one has for the wild landscape relative to the size of the risk and potential losses from wildfire. If we look at that closely, if may not be "economical" to do clearances. Even when only the potential loss of a house is considered, it may not "pay" to do clearances given a relatively improbable fire and the protection of insurance. How can we make firesafe practices have a higher relative advantage?

It should also be possible to try the firesafe idea out a little at a time. That is hard. One can never really try it out without a fire. However, again, careful use of the mass media and local interpersonal contacts, maybe with simulators of some kind, can help people apply the firesafe idea to their own situations. Related to this is the need for the firesafe practices to be adaptable to different situations. Everyone faces a different environment and economic situations. If there is only one kind of firesafe, it will not fit everyone's needs.

Slide 3: (Awareness) Having analyzed the communication systems available to you and the technology, you are ready to begin promoting. The first step is to create awareness. This is where mass media can be very effective. However, it is important to make sure the opinion leaders in the communities know about the new idea and have a

positive attitude toward it before people start asking them about it. That usually means that you have to make personal contacts with opinion leaders directly or through organizations they belong to. Direct contact is most effective.

Awareness means that people know about the idea and can see some potential application to their situation. They haven't developed an attitude about the idea yet. Persuasion is the next step in the process of deciding to adopt or reject the idea.

Slide 4: (Persuasion) During the persuasion stage, people form attitudes and opinions about the new idea. This is where people will decide whether firesafe is a good or bad idea as far as they are concerned. They will consider the relative advantages, the compatibility, and the complexity of the idea here and whether it can be adapted to their particular situation. Opinion leaders will be very important at this stage. If you work with the opinion leaders, there is a good chance that the community will decide firesafe is a good idea. If you don't, there is a very good chance that the decision will go against you.

Opinion leaders are people who can influence how other people feel. There are several techniques for identifying opinion leaders. One of them is pretty simple. On the Hayfork fire, we identified key communicators and opinion leaders in less than six hours and had a public meeting. I wouldn't advise that as a way to do it on a typical basis; you usually want to be more careful in sorting out the key communicators. You can use a technique called sociometry, or you can use people in the community who are experts and can tell you who the people are who might influence opinions there. If you get one expert to give you a list, another expert to give you a list, and another expert to give you a list, you can then compare lists; people who show up on all three lists are probably influential. Officers of clubs and other service organizations make good experts. Validate that with some other people, and you've got a rough-cut idea of who the opinion leaders are. Those are people you've got to work with.

At the persuasion stage, interpersonal media should be used; there's nothing you can do with the mass media. This doesn't mean you going out and talking to people, although you need to talk to the opinion leaders in person. At this stage, people talk to their opinion leaders; the opinion leaders need to have the right idea. You spend your time with those opinion leaders; when other people contact them, they'll be able to say, "Yes, that's a good idea."

Slide 5: (Decision) At the decision stage, people make a commitment. You might have to do some things to help out. They might need low interest rate loans. You may need to provide lists of horticulturists or landscape architects who can provide adequate designs. There are many things that people don't really know how to handle at this point. One of the things we found in promoting firesafe was that we ended with brush and debris piled up around houses. Not exactly a firesafe situation. One of the things we had to do right away was to get that brush to a safe place to store it. We know in much of California that when people decide to adopt firesafe practices, they clear their brush, then in the spring they rush to get it burned before fire permits are required, and we end up with escaped debris burns. Often, even after people are persuaded that a new idea or thing is good and feasible, they stall at the decision stage. This is especially true of preventative innovations such as firesafe.

Slide 6: (Implementation) Here's where people have to get it done. Are there people they can hire to do clearing? In Hayfork, we had some elderly people. There was no way they were going to go out and clear around their property. They didn't have the ability to do that. They didn't have the tools to do that. We worked with people from the high school who organized students to clear property for the elders. Implementation is not something that automatically happens.

Slide 7: (Confirmation) At this stage, you can use both interpersonal message and mass media; they're still going to be checking with their opinion leaders. You can use mass media to some effect by describing benefits, houses that have been saved, other kinds of benefits that people can relate to. You can use public meetings; you can provide awards; there are all kinds of things you can do to enhance the idea in people's minds that firesafe was a good idea.

Slide 8: (Crisis) Now, the kinds of things we're dealing with are called preventative innovations. They're the same kinds of things as wearing seat belts, motorcycle helmets, getting a chest X-ray, having your teeth checked, all those things you put off. We find that for preventative innovations, crises are a very good time to get people started. We're talking about getting to a specific neighborhood that has a fire department nearby and that's got a hazard that's identifiable. Any kind of fire crisis, whether it's in the community or nearby can be enough to get people's attention and allow you to move them forward in the decision-making process.

Now, the crisis only has an affect for a little while. I think this year's California fires have a tremendous effect right now. In Hayfork, it certainly did. We went out and started doing a little clearing around a place as a demonstration, and the neighborhood started coming out and watering down their houses, they were sure the fire was coming into town. It probably would have been a good idea not to wear our nomax as we were doing that. Anyway, the awareness was there, and it didn't take long to go through the stages between persuasion, decision, and action. It moved to action pretty fast. You can take advantage of those things, but next year, it's going to be harder and the next year, this year's fires won't have much effect at all in terms of getting people to move through the decision process.

Let me summarize some of the main points. First you need to adopt the receiver's orientation to communication about firesafe and give up thinking like a source. You won't be successful in communicating the firesafe idea to people in the urban/wildland interface unless you match your messages to the kinds of things those people are looking for, put the messages in the media that they use, and put it there during the times when then are looking for that kind of information. The receivers, like trout, are in control of the situation; promoters and fly-fishers are not the ones in charge. In communication, as in fly-fishing, success depends on your ability to "match the hatch." Here are some things to keep in mind:

1. Focus your promotion efforts on local neighborhoods or communities. Avoid total reliance on messages broadcast to the public at large.
2. Before you begin, find out about the mass media and informal communication channels available to and used by the people in the neighborhoods you have targeted.
3. Evaluate the firesafe "technology" as it is perceived by people you want to adopt it. How do they see it in terms of compatibility with their values and beliefs? What relative advantages and disadvantages do they see if they adopt? How complex do they feel implementing or understanding firesafe is? Do they feel the idea can be modified to their own particular situation successfully? Can it be tried out a little at a time? Can they easily see the benefits of adopting? Can people tell when others have adopted?
4. Given the results of your "technology assessment," modify the firesafe idea so that it is acceptable and desirable to the people who will be asked to adopt. It is much easier to change the characteristics of a thing like firesafe than to change people's tastes, preferences, and attitudes.
5. Use different communication channels and emphasize different characteristics of firesafe at different times during the process of decision making.
    a. Mass media are good at the awareness stage. Take advantage of fires that occur near the community to show how fire behaves and how firesafe will help save things that are valuable to them. Emphasize the positive--show houses that were saved because the right things were done instead of houses that were lost because the right things were not done.
    b. Interpersonal communication among people in the neighborhood and between people and their opinion leaders is the most important, almost the only important communication at the persuasion stage. People will be most concerned about the compatibility and relative advantage of firesafe at this time.
    c. At the decision stage, both interpersonal and mass media can be used effectively. Both should be used. At this stage and during implementation, people will need "how to do it" and "where to get it" information.
    d. Don't forget the confirmation stage. Especially with something like this, it is necessary to continue to reinforce the decision to adopt. Use mass media demonstrating the wisdom of adopting firesafe by telling success stories. Work with local opinion leaders one on one.
6. If you want to know more about the ideas behind these suggestions, read this book and a very recent text in marketing. I have used ideas from Rogers to a great extent in preparing this presentation.

Rogers, Everett M. 1983. Diffusion of Innovations. (3rd ed) New York: The Free Press.

SESSION 4--WORKSHOPS

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HELPING HOMEOWNERS AND DEVELOPERS UNDERSTAND

WILDLAND RESIDENTIAL DEVELOPMENT PROBLEMS

Notes from Workshop No. 1
Workshop Leader: Bob Lee
Facilitator: Ginny Tribe

The overall purpose of this workshop was to gain a better understanding of homeowners, developers, fire service officials, and elected officials. Also, how understanding ourselves in our various professional roles is equally important to understanding how homeowners and developers can come to grips with wildland residential problems.

Workshop participants were divided into four groups, and each addressed a different theme by identifying problems or obstacles and solutions as follows:

GROUP 1: HOMEOWNERS

The purpose of this group was to give a better understanding of how developers and fire agencies, by giving quality information, can motivate homeowners to protect their homes and at the same time prevent fires.

The following are problems dealing with homeowners and solutions.

1. Life saving communications to the homeowner can change behavior through:

    a. Schools/children
    b. Posters
    c. Community events
    d. Personal contact
    e. T.V. spots/media support
    f. Detail for informed decision

2. Early awareness of fire hazard will affect decision process:

    a. Statutory recognition of problem
    b. Subdivision review process
    c. Purchase of property - person advised of conditions
    d. Actual building processes

3. Motivational factors:

    a. Personal
    b. Economic
    c. Community

4. Pride of ownership:

    a. Compliment positive actions/recognition
    b. Show examples of "good silvicultural practices" which enhance value and reduce fire hazard
    c. Competitions and recognition by agencies

5. Specific documentation of money savings for fire hazard reduction:

    a. Insurance
    b. Resale value documentation
    c. Identify items you do not want to lose
    d. Clarify the non-replaceables

6. Identify community goals:

    a. Reduction of ISO rating
    b. Fire training:
        1. Escape plans (individual community)
        2. Space and vegetation management for aesthetic/landscaping/fuel management
    c. Community action manpower mobilization
    d. Community "fire organization"

7. Counteract denial (there is no problem) with information:

    a. Identify credible referral source
    b. Focus on positive by identifying successes elsewhere

8. Communication skills:

    a. Problem manager
    b. School level - intervention
    c. Inservice management and communication skills
    d. Legislative or statutory framework for related hazard reduction/mitigation

The major themes were to inform the property owner (choices), give demonstrations, and communication skills.

Workshop Report developed at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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GROUP 2: KNOWING OURSELVES

The purpose of this group was to better understand ourselves and how we, in whatever role we play, as homeowners or agency people, are part of the problem and hence part of the solution.

1. Obstacle: Local acceptability of prescribed burning within the community.

Solutions:

a. Good smoke management
b. Awareness of different types of smoke
c. Provide services, technical expertise
d. Liability
e. Cost versus mechanical versus chemical

2. Obstacle: Agencies acceptability of prescribed burning within the community.

Solutions:

a. Concepts behind why to burn
b. Training, technology transfer on how to burn
c. When to burn, smoke management, air quality
d. Multi-year fire planning and budgeting
e. Education, public support for program
f. Liability (Florida, Chapparal Management)

3. Obstacle: Country living is different. Homeowner is on their own. "Welcome Wagon" packages from fire department.

Solutions:

a. Training, work with local county officials, real estate, banks, insurance
b. Restrictions on deed-restrictive covenant
c. People within small area, community restrict or do not restrict themselves
d. Fire service user rates - incentive to reduce rates by doing certain things to home or property

4. Obstacle: We try to dictate to independent people.

Solutions:

a. Good persuasive communications - make them have ownership in the ideas
b. "Carrot sticks" first, enforcement second
c. Training of fire service personnel
d. Positive strokes for those homeowners doing good

5. Obstacle: Perceiving the solution as coming from the outside.

Solutions:

a. Encourage employees/officials to be part of the community
b. Determine and publicly identify who is

6. Obstacle: Leaders do not understand our purpose here (reference Melcher speech).

Solutions:

a. Involvement of homeowner groups, staff people, officials in educational functions, workshops, symposiums
b. Lobby officials by state staff officials
c. Report successful communities to legislator
d. Send letters to legislators, county officials

7. Obstacle: Sometimes need a crisis (for example, house next door to burn), to get homeowners' attention.

Solutions:

a. We may have public's attention, enough houses have been burned
b. More awareness, education
c. Local fire services need to agree and present a unified/cooperative answer

8. Obstacle: How safe is safe? Where do you need to stop on fire-safe measures?

Solutions:

a. Assemble knowledge from grass roots
b. Photo-guides, risk source ratings
c. Cost and New Value Charge (C&NVC)
d. Reduce uncertainty to point where the risks are known

GROUP 3: PLANNING CONSULTANTS

The purpose of this group was to further a better understanding of developers, and the process by which regulations are formulated and implemented.

1. Negative Influence: Different objectives.

Solutions:

a. Communicating and learning anothers objectives

2. Negative Influence: Lack of understanding of fire management/developers objectives.

Solutions:

a. Define common objectives

3. Negative Influence: Short run economic considerations - 1) cost of capital facilities, 2) water, 3) access, 4) site development, 5) construction techniques, 6) vegetation modification.

Solutions:

a. Negotiation to a common solution/standards

4. Negative Influence: Bad past experience.

Solutions

a. Recognize your own biases

5. Negative Influence: Increase risk to the resource with increased use.

Solutions:

a. Through use of regulations (site standards) and education (initial and continuing education)

6. Negative Influence: Red tape.

Solutions:

a. Streamline process via knowledge of system
b. Uniform standards for submittals

7. Negative Influence: Lack of incentives to cooperate/administrative inflexibility.

Solutions:

a. Is a fact of life

8. Negative Influence: Lack of support between agencies and governing bodies and lack of authority in the political process.

Solutions:

a. Better communication between agencies

9. Negative Influence: Lack of authority to make decisions at initial contact level.

Solutions:

a. Delegate authority and understanding own authority

10. Negative Influence: Time constraints relative to decision making and work load constraints.

Solutions:

a. Adopt reasonable time constraints

11. Negative Influence: Curriculums do not teach new technology, and lack of curriculum on communication and negotiation.

Solutions:

a. Provide more opportunities for relevant education in communication, negotiation, in new technology (make your needs known)

12. Negative Influence: Economics of providing fire suppression to residential development.

Solutions:

a. Innovative financing methods (working with the developer)

13. Negative Influence: Lack of interest in continuing education.

Solutions:

a. Economic incentives for continuing education

14. Negative Influence: Lack of system for initial communication between developers and agencies.

Solutions:

a. Set up a system

15. Negative Influence: Lack of consistent standards.

Solutions:

a. Adopt and hold to consistent standards

16. Negative Influence: Concerns of special interest groups and precedent problem.

Solutions:

a. Realize they are there.

GROUP 4: AGENCIES

The purpose of this group was to better develop an understanding of fire service agencies and how they can contribute to solutions to the residential wildfire problem.

1. Problem: Economics - 1) expensive to remodel, 2) insurance disparity, 3) developer - short term planning.

Solutions:

a. Tax incentives
b. Loan incentives for fire safety features

2. Problem: Lack of agency cooperation.

Solutions:

a. Continue further interagency involvement

3. Problem: Media misinformation.

Solutions:

a. Communication

1. Agencies educate media
2. Tailored to "target" group (for example, different homeowner groups, developer groups, etc.)

4. Problem: Lack of agency understanding of culture tradition.

Solutions:

a. Agencies understanding local situation

HOW TO COMMUNICATE THE WILDLAND RESIDENTIAL FIRE PROBLEM TO POLITICAL LEADERS

Notes from Workshop No. 2
Workshop Leader: Gary Severson
Facilitator: Sandy Matheny

I. Identifying Barriers to Effective Communications with Political Leaders

A. General Barriers

1. Lack of knowledge/understanding
2. Lack of priorities/time/dollars
3. Poor credibility/lack of trust
4. Unwilling to deal with the issues
5. Resistance to agency input
6. Lack of adequate funding
7. Resistance to agency interference
8. Pro-economic development - Resistance to impairing regulations
9. Avoid conflict
10. Lip service
11. Constant change in elected officials
12. Don't know individuals
13. Not interested in unpopular issues
14. Technical jargon
15. Not in the network - don't participate
16. Influenced by special interest groups
17. Don't know protocol
18. Lack of trust
19. Change in elected officials
20. Shortage of money
21. Knowledge of the issues
22. Competition for funds (police versus fire)
23. We (firemen) don't always do "homework"
24. Time and scheduling
25. Insufficient preparation or report time
26. Personal agendas
27. Many diverse constituents
28. Availability of professional staff
29. Personality conflicts
30. Conflict of interest
31. "Fox guarding the hen house"
32. "My mind is made up, don't confuse me with the facts"
33. Obtaining approval of supervisor to approach political leaders
34. Time, energy, money to organize program to present to political leaders
35. Minority viewpoint does little to create pro-active posture from political representative or entity
36. Continuity among multiple jurisdictions
37. Identification of political leaders with responsibility - "whom do you address?"

Workshop Report developed at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Gary Severson is President, Dynamic Horizons, Evergreen, CO.

Sandy Matheny, Idaho Panhandle National Forests, Coeur d'Alene, ID.

38. Time constraints, primarily theirs

39. Differences in priorities, limited resources, money, etc.

40. Pressure groups with adversary agendas

41. Lack of consensus among all players

42. Lack of coordinated communication between agencies and lawmakers

43. Political terms

44. Technical expertise

45. Time

46. Accessibility

47. Issue priority

48. Competition for money

49. Existing current fire laws

50. Time involved in political process

51. Campaign funding

52. Public opinions

53. Lack of trust

54. Protocol

55. Personality conflicts

56. Agency lacking political savvy

57. Political leaders (county commissioners) having faith/trust in judgment of Federal employees that a problem does exist

58. Political leaders not supportive of exiting laws/regulations regarding fire due to political pressure (contractors, developers)

59. Dissimilar agendas

60. Issues: Statewide versus Regional

61. Can we show financial aid (small community)?

62. Small amount of locals are supportive

63. Understand/believe that a problem does exist before an incident occurs

64. Jurisdiction (turf)

65. Over-scheduled politicians

66. Lack of access

67. Supportive groups (who - rural, VFD, etc?)

68. Anti-government and State feeling

69. Financial - will it cost?

70. Jargon (define)

71. Travel - cost to visit meetings

72. Is there organizational support?

73. Lack of understanding of local politics

74. Party politics (overrides)

75. Agency politics

76. Being compromised

77. Dislike of politicians

78. Tendency to delegate authority

B. Priority Barriers

1. Broken communications (see solution II-A)

2. Lack of trust (see solution II-A)

3. Non-interest (see solution II-B)

4. Lack of awareness (see solution II-B)

5. Non-election issues (see solution II-B)

6. Non-similar agendas (see solution II-B)

7. Lack of awareness of agency policy (see solution II-C)

8. Misperception of agency procedure (two-way) (see solution II-C)

9. Anti-agency attitude (see solution II-C)

10. Personalities (see solution II-D)

11. Old battles (see solution II-D)

12. Preconceived ideas how to do things (see solution II-D)

13. Logistics - funds, time, solutions (see solution II-E)

14. Political pressures caused by constituents, special interest groups and the media (see solution II-F)

15. Financial constraints (see solution II-G)

    a. Any costs - they are not interested in the project

    b. Project may not fit within their priority

16. Lack of trust in fire officials (see solution II-H)

17. Their time - my time; matching calendars, prework, meeting length (see solution II-I)

18. Inform them on the problem (see solution II-J)

    a. Predetermined attitudes

    b. Resistance to change

19. Lack of knowledge/understanding

20. Lack of time

21. Not interested or not our problem

22. Poor credibility between agencies and political leaders

23. Higher priority issues than yours

24. Many diverse constituents

25. Conflict of interest

26. Knowledge of the issues

27. Firemen (foresters) don't do "homework"

28. Not interested in unpopular issues

29. Time, energy and money to organize program to present to political leaders (see solution II-V)

30. Minority viewpoint does little to create pro-active posture from political representative or entity (see solution II-W)

31. Time constraints primarily theirs (see solution II-X)

32. Differences in priorities, limited resources, money, etc. (see solution II-V, W, X)

33. Pressure groups with adversary agendas (see solution II-Y)

34. Lack of consensus among all players (see solution II-Y)

35. Lack of coordinated communication by agencies (see solution II-Z)

36. Issue priority (see solution II-Z)

37. Competition for money (see solution II-Z)

38. Time involved in political process (see solution II-Z)

39. Anti-government and State feelings (see solution II-AA)

40. Trust (see solution II-BB)

41. Understanding/believing a problem exists (see solution II-CC)

42. Turf (see solution II-DD)

43. Financial (see solution II-EE)

II. Identifying Ways to Develop Effective Communications with Political Leaders

A. Be honest, patient. Build on relationship in short exposures. Admit mistakes and/or limitations of self or agency.

B. Build early broad based coalition. Look for common ground. Develop concise fact case. Be patient. Develop the community networkers or key contacts.

C. Create a two-way understanding of policy, procedures, and responsibilities early.

D. Be alert that these may exist and try to avoid them. Pick out people you can deal with and work with them.

E. Be concise. Provide suggested solutions and alternatives, if possible.

F. Identification and education of groups. Anticipate groups concerns/questions. Involve interest groups in the solution. Take personal time in educating media representatives. Use an integrated approach that involves all players. Build consensus.

G. Be able to explain cost/benefits. Be able to explain trade-offs. Know what the project is before trying to solve financing needs. Use volunteers. Research different types of grants, gifts, etc. Involve other persons/agencies.

H. Maintain good communication. Do not wait until you have a problem to develop a relationship. Admit mistakes. Try to find/talk with a person who knows the political leader (educate yourself). Do what you promise to do. Tell leader that you (your group) is willing to do the work.

I. Scheduling a meeting in advance to meet their needs. Keep meeting short. Be flexible to accomodate their changing time needs.

J. Be prepared for meeting.

   1. State problem that this political leader can solve - use visuals

   2. Tell why it is a problem

   3. Identify possible solutions

   4. Provide recommended approach

K. With a united group build and maintain credibility with elected officials.

L. Provide information, education, examples.

M. Provide options to solve problems (pluses and minuses).

N. Suggest process of logical implementation.

O. Supply support and assistance.

P. Inventory and identify where support exists/does not exist.

Q. Educate and inform public.

R. Build and consolidate support.

S. Develop briefing package.

T. Pick champions to help out.

U. Learn procedures, process, and key people.

V. Set internal organization priorities.

W. Build strong vocal coalitions with grass roots support prior to political contact.

X. Information to political leaders in advance of becoming a political issue.

   1. Concise information

   2. Precise solutions

Y. Identify these groups.

   1. Communicate

   2. Reach consensus (compromise)

   3. Meet on their turf

Z. Interagency cooperation and coordination.

   1. Define problem

   2. Develop solutions

   3. Develop plan

AA. Identify feelings and go to grass roots and let them go to local government for you. Gain support of some other local agency.

BB. Avoid 49% of non-interested. Be positive to gain allies.

CC. Clearly identify concern. Then go with education. Use a coalition.

DD. Identify problem clearly. Determine boundaries.

EE. Do your homework. Have alternate choices. Look at risk factors for each solution. Show benefits. Be sure and prioritize.

HOW TO COMMUNICATE ABOUT THE WILDLAND RESIDENTIAL FIRE PROBLEM WITH HOMEOWNER GROUPS

Notes from Workshop No. 3
Workshop Leader: Ron Hodgson
Facilitator: Judy Norgaard

The most important result of this workshop was the insight gained into the kinds of things that might prevent effective communication between homeowners and the fire services and those that might make it easier, if taken advantage of. The summary will, we hope, be used by researchers to identify areas where we need to know more and by managers to establish communication goals and objectives.

Groups of workshop participants have considered characteristics of the fire services, homeowners, and the fire safe practices themselves. The situation faced by homeowners and the fire services before, during, and after the fire were evaluated to specifically suggest communication opportunities and difficulties.

GROUP 1

The characteristics of the fire services and their situations that make it difficult to communicate with homeowners about wildfire and fire safe practices before, during, and after a fire.

Before a fire

Regulatory controls.

Economics - Manpower/Agency
Cost/Homeowner

Environmental handicaps.

Fire service attitudes

Dream Filter System - People find it hard to deal with the reality of fire. "It can't happen to me" syndrome. Insurance coverage helps to justify.

No Common Bond - "Neighborhoodism" prevents common bonding between homeowners and fire service.

Jurisdiction - "Who should" attitude.

Politics.

Residential types - Native versus transient.

No past history of problem.

During a fire

No media.

Fire service is preoccupied with fire suppression.

Homeowners are not receptive to communication during holocaust.

Homeowners receiving information from mass media are often overwhelmed with sensationalism.

No public relations department to handle inquiries.

Absentees.

Lack of qualifications and/or equipment.

Homeowners lack understanding of qualifications and/or equipment.

Agency responsibilities and priorities.

After a fire

Fire service is busy defending suppression actions.

Nature of homeowners emotions - Armchair "Incident Commanders".

Litigation - Cannot discuss with fire service, peers, etc. Almost like Court "Gag Order".

Credibility.

Media subjectivity.

Identification of whom to talk to. Agency, opinion leaders, etc.

Workshop Report developed at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Ron Hodgson is a Professor, California State University, Chico, CA.

Judy Norgaard is Public Affairs Specialist, U.S. Department of Agriculture, Forest Service, Washington, DC.

Hidden alligators - Local versus out-of-area overhead team.

Who does rehabilitation?

GROUP 2

The characteristics of the fire services and their situations that make it easy to communicate with homeowners about wildfire and fire safe practices before, during, and after a fire.

They are perceived as helpers. They save lives and property and rescue cats. (Before, during, and after fire.)

Fire service personnel are "regular people". They have a lot in common. They're a neighbor. (Before, during, and after.)

They have technical credibility through experience and knowledge. (Before, during, and after.)

They have personal credibility (Before, during.)

They have high visibility. (Before, during after.)

They have a good image. (Before, during, after.)

They are generally dealing with people in positions of authority. (During, after.)

The service personnel represent the lowest level of a Government entity. (Before, during, after.)

Homeowners' fear of fire and lack of knowledge allow easier communications with fire service personnel. (Before, during, after.)

Current events - Actions speak loud during or immediately after fire. (During, after.)

When economy is low people will tend to be more protective of belongings. (Before.)

Established organizations, equipment, and techniques used allow for better communications. (Before, during, after.)

Fire services have something to gain - a reward system. (Before, during, after.)

Fire service personnel are deservedly perceived to be motivated and dedicated. (Before, during, after.)

Playing on human tragedy tends to open lines of communication. (Before, during, after.)

Negative/positive. (Sometimes before, during, after.)

GROUP 3

The characteristics of the homeowners and their situations that make it difficult to communicate about wildfire and fire-safe practices before, during, and after a fire.

Fire service diversification. (Before, after.)

Homeowners' priorities. (Before, after.)

Outdated codes. Yesterday's regulations do not meet today's standards and today's standards will be outdated tomorrow. (Before, after.)

Migration to and from area inhibits better communications. (Before, during, after.)

Fear of regulations - more economic/personal choice than aesthetic. (Before, during, after.)

Bending the codes. "Rules are made to be broken". What guidelines are to be followed? Is nothing sacred? (Before.)

Natural groupings. Associations, absentees, etc. (Before.)

Diversity. Should they bless or damn the covenants? Based on economics. (Before, after.)

Disorganization. Who should do what, when, and how? Causes chaos. (Before, during, after.)

Silent (deaf) bureaucracy. (Before, during, after.)

Unfamiliarity with language, jargon. (Before, during, after.)

Coherent approach by fire service. (Before, during, after.)

Rumor control, or lack of. (Before, during, after, and on and on and on...)

"Big Brother" syndrome. (Before, during, after.)

Preconceptions - any or all. (Before, during after.)

Additional Comments

How can safety be taught when homeowners are forced to leave scene during fire? They will demand to stay regardless of knowledge about fire hazards and/or safety. Double-edged sword.

GROUP 4

The characteristics of the homeowners and their situations that make it easy to communicate about wildfire and fire safe practices before, during, and after a fire.

Before a fire

Common bonds: Survival - (a) life; (b) investment; (c) aesthetics (prevent fire to preserve).

Feelings of control, independence - (a) avoid intervention; (b) exploit self-reliance; (c) form own Homeowners' group.

Sense of community - (a) peer pressure on irresponsible homeowners; (b) "same boat" attitude; (c) pride in neighborhood.

Exploit leadership inherent in the community; use as catalyst.

Children play primary role in changing adult behavior. Reach children.

Choices: Appeal to income and ability levels in the community with (a) private consultants; (b) Government advice - use permit property users - they're used to dealing with government; (c) community help, etc.

Exploit homogeneity of community, that is, the approaches must fit the community's nature.

Nature of ecosystem - communication based on the type of fire in the specific area.

Education.

During a fire

Survival - opens minds toward better communications.

Psychological - community reaction, education applied, fuel removal as fire progresses.

Stress enhances motivation.

After

Experience - evaluation: (a) prevention practices that work or need modification; (b) being open to learning about fire ecology - post-fire succession and species to re-introduce; (c) motivation - increased sense of community, focused interest due to common experience; (d) home destroyed - insurance money to rebuild - open to building fire safe structures.

Additional Comments

People don't perceive "natural events" until they are the victim.

Learn by watching.

Incensed by the idea that adults don't want to learn. There are many ways to accomplish learning. People can't help but learn, short of being brain dead, but knowledge should be applied. In short, adults don't change easily.

Represent innovators.

"Multiplier effect" - use to educate adults,

People are receptive and willing to promote.

GROUP 5

The characteristics of fire-safe practices themselves that make it difficult to promote them.

Fuel modification

Altering the "natural beauty".

Conflict with perception of what should be.

How do you get rid of it?

Disposal conflicts with regulations.

Cost.

Resistance to authority.

"Big Brother" syndrome.

Suppression Tactics

Homes - Direct.

Wildland - Indirect.

Public asks why.

Roof Materials

Covenants.

Architectural ego.

Public perception of aesthetics (elected officials).

Cost of removal of slash, etc.

Industry lobby.

Social Status.

Site Selection of Planning

Developer won't accept fact that there is a hazard and/or cost.

Fire services too late into the process.

Local government does not realize problem - hazard and fire behavior.

30/30 syndrome.

Vested interest of developers.

Access

Cost.

Misconception of what is aesthetic.

Takes wilderness out.

Encourages transient visitors.

"Crime rate" goes up.

Water Supply

Cost.

Fire Safe Education

Want city protection in rural atmosphere.

Jargon ("fuel", "Ecosystem", etc.)

Time constraints and money.

Emphasis is on suppression rather than education.

Complacency (apathy) - important concern.

Media gives wrong message.

Real estate industry is not in tune to problems.

Public lacks perception of the "unnatural" fuel situation.

Additional comments

False advertising after the fire. Very susceptible to fraudulent claims.

Exploitation.

It's relatively easy to get support and/or man-power through Homeowners' meetings. Follow up with handouts; hands-on material to put information into practice.

GROUP 6

The characteristics of fire-safe practices themselves that make it easy to promote them.

Personally cost-effective, if practiced.

Personal safety.

Enhances resale value of property.

Owner/occupant liability, if don't comply.

Perceptions of being logical.

Perception of social acceptability, follow neighbors' lead.

Perceptions of aesthetics, over-doing it.

Safety of mementos, belongings.

Feeling of inner comfort, doing everything possible.

Satisfaction of being in compliance.

Synergistic benefits of effects. Each one enhances itself. Some can have more than a single effect.

Economics remuneration from following safe practices.

Additional comments

Sometimes imagery is tarnished through perception, based on previous opinions.

USING WILDLAND RESIDENTIAL STANDARDS, LAWS, AND REGULATIONS FOR PROTECTION NOW AND IN THE FUTURE

Notes from Workshop No. 4
Workshop Leader: Gary Tokle
Facilitator: Ed Heilman

This workshop was conducted in three parts:
1) a panel discussion consisting of Dick Bacon, Tim Murphy, Rich Schell, Jo Bridges, and Don Wood,
2) a question, answer, and concern session, and
3) identification of five key issues.

PANEL DISCUSSION

Dick Bacon, USFS Fire Planner, Washington, D.C.

Urban interface is the most complex political area we work in and a very sensitive one. We need to take a look at the long-term objectives as a partnership.

We need to focus on the correct objectives:

- Minimize loss of life and property
- Minimize cost of fire protection and losses
- Minimize drain on our equipment
- Community standpoint

Our objective is to "develop defensible homes and defensible property. It is not to eliminate shake and shingle roofs".

Basic Assumptions:

1. Regulations developed at the Federal and State Government level create problems. People's perception is that personal rights are being taken away. One alternative would be to work with the insurance companies.

2. If the local community develops the regulations, they feel their rights are protected. Most people want a choice.

3. We can't develop regulations at the National or State level that will cover all situations.

Three categories of rules when developing regulations:

1. Adjacent property owners - need to be sensitive to their concerns

2. Work with developers - cost effective/reasonable

3. Work with residential homeowners

Responsibilities:

As consultants or advisors, we need to facilitate and offer reasonable alternative solutions. We need to help the public understand the economic implications of regulations. And we need to provide a framework to evaluate various strategies.

Most of us believe regulations are necessary; we have the technical knowledge, now we just need to go to work.

Recommendations:

1. Support NFPA effort to develop national standards and guidelines.

2. Encourage each state to generate standards and guidelines.

3. Provide assistance to states - Coop Fire Protection.

4. Develop regional or national evaluation system to evaluate the needs of the communities.

5. Need local studies in 2-3 years.

Tim Murphy, Chief, Division of Fire, Department of State Lands, Missoula, MT.

In order to make regulations and standards, first we need to understand the system and the components. There are four major components:

1. The Public - most people move to these areas to get away from people, they want to "get back to nature." Most don't understand the problems and the risks. They feel secure with their local fire protection agency.

Workshop Report developed at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Gary Tokle is Senior Fire Service Specialist, National Fire Protection Association, Quincy, MA.

Ed Heilman, International Fire Council, Missoula, MT.

2. The Developers and Planners - most convey the message that wood construction is more natural, minimum improvements preserve the natural setting, seclusion and privacy take precedence.

3. The Fire Service - in many cases doesn't fully understand the problem, isn't willing to implement certain measures and often reinvents the wheel.

To effect change, the fire service must complete fire hazard and risk analyses, maximize prevention and public education programs, develop interagency fire pre-plans, maximize interagency cooperation and coordination, and send a uniform message to the public.

4. The Lawmakers, Regulators, and the Courts - at local, state, and national level, need to look into fire insurance rates that reflect actual probability of destruction by fire, interest rates that encourage fire-safe design and construction, tax incentives, tax penalties, cost share. We need to encourage legislation.

A standard is what is acceptable. We need standards to know where we are going and how to get there. Adoption of a basic set of standards by NFPA is a foundation for local standards, regulations, statutes and minimum protection requirements. NFPA needs to prepare and finalize such a standard. With a national guideline, local authorities can establish their operations and control through implementation of general plans, zoning and developmental plans.

Through the above four inter-related components, we can effect change through education, engineering and enforcement to achieve excellence within the Fire Service and the protection of homes from wildfire.

Rich Schell, California Department of Forestry and Fire Protection, Sacramento, California.

Mr. Schell shared California's approach with the group, commenting that there are different social and political pressures and there is no single approach.

He gave a chronological presentation from 1962 to 1987:

1962 - The California Department of Forestry and Fire Protection (CDF) publicized the problem of protection in the wildland/urban interface areas.

1965 - First step to develop and adopt fire safety publication. Discussed need for fire protection planning, identifying hazardous fire areas. Proposed minimum fire safety requirements for subdivisions and developments.

1967 - Passed into law a series of regulations related to perimeter encroachment into wildlands, clearance around structures, and regulations concerning campfires, powerlines, small engines, etc.

1971 - State moved into planning process. Provided guidance to local government. Major fires gave opportunities to implement. Many counties were inconsistent, some non-compliant, and others very stringent.

1980 - USFS and CDF updated publication to optimum standards rather than minimum standards.

1981 - State legislation required CDF to identify fire hazard severity zones that specify the potential intensity of wildfires that threaten to destroy resources, life, or property. Fire resistant roofing regulations.

1984 - FS and CDF proposed to insurance industry an incentive program with homeowners. Reduced rates were flatly refused by the insurance industry.

1987 - CDF and California Board of Forestry introduced legislation to require contractors and developers to incorporate self-protection measures in wildlands whether it be residences, commercial, or camps.

Two other programs Mr. Schell mentioned included a cost share vegetative management program and a series of workshops in California co-sponsored by CDF and USFS to develop a framework to implement defensible space in terms of Fire Safety Program.

Jo Bridges, Community Planner, USFS, San Bernardino, California

Ms. Bridges spoke of a success story which was born out of the Panorama Fire in San Bernardino. Following the fire, the USFS did a feasibility study of greenbelt options running the length of the county. They looked at all aspects and involved 14 other agencies. It was determined that the traditional greenbelt (golf courses, parks, agriculture land) was not appropriate for most of the area.

Recommendation of the feasibility study was to continue working together in two areas:

1. Public information area

2. Develop standards that would apply across jurisdiction lines

They have worked out the above two areas and have delineated hazard zones. Standards have been implemented by the city and county.

However, the county adopted the ordinances December, 1986 - 6 years after the Panorama Fire, about 25 years too late. The area is already 75 percent built out. We can't sit and wait for disaster to happen.

There are two areas that need emphasis in the future:

1. Public involvement/awareness

2. Involvement of USFS. The involvement of the FS in this case was unusual. The FS is usually reluctant to get involved in traditional local jurisdiction. Would like to see a continuance of this cooperation.

Don Wood, Consulting Forester, Corvallis, Montana

Mr. Wood identified five points concerning people living in the wildland/urban interface areas:

1. People move out to these areas because they like to solitude, they love wildlife, the scenery, the wilderness and the independence and freedom. They are not convinced there is a problem from fire.

2. Positive reinforcement is more effective than punishment.

3. We need to advertise, publicize and educate. No everyone perceives the problem in the same way.

4. People need to be introduced to the subject slowly. Allow the people to go through their own thought process. Allow them to think of solutions.

5. Homeowner involvement is the most important step. It allows the people to exercise their independence.

We need to find rational solutions rather than dictate unreasonable requirements.

KEY ISSUES

The group discussed a wide range of issues. They developed the following prioritized list of five key issues that need to be addressed:

1. Develop standards for identification, rating, and modification of wildland fuels for property protection, including provisions for long-term maintenance.

2. Develop long-term education and publicity programs to include the following audiences:

- property owners
- residents
- building and design professionals, including developers
- school programs
- fire fighters
- legislators
- local government

3. Develop subdivision and building design criteria for wildland/urban interface areas. These criteria should recognize differences between fuel conditions, be coordinated between agencies, and established at the lowest possible government level.

4. Develop incentives to encourage voluntary compliance with fire safety regulations and standards.

Examples:
- insurance incentives
- tax and assessment incentives
- incentives between levels of Government (that is, distribution of funds)

Coordinate effects of incentives between Government entities. As an example, when a credit is given for a type of improvement, that credit is not then offset by higher assessments.

5. Develop guidelines to involve residents and property owners in development and implementation of wildfire prevention standards.

COOPERATING WITH THE MEDIA TO PROMOTE FIRE MANAGEMENT IN WILDLAND RESIDENTIAL AREAS

Notes from Workshop No. 5
Workshop Leader: Jamie Haines
Facilitator: Steve Laursen

This workshop focused on using the media to transmit fire management information to the general public and urban/wildland interface homeowners. Two basic questions were addressed:

1. How do we best work with the media during an actual wildland fire crisis?

2. How do we best work with the media to communicate the need for homeowners to engage in fire prevention activities in wildland/urban interface developments?

SESSION I: FORMAL PRESENTATIONS

Four speakers presented their perspectives relative to the two basic questions:

Lori Sharn, Reporter for USA Today

Suzanne Lagoni, Communications Director for Montana Senator Max Baucus

Beth Horn, Staff Director for Information, USFS, R-1

Gladys Daines, Manager, Smokey Bear Program, USFS, Washington, DC

Brief summaries of their presentations follow.

I. Lori Sharn - National Perspective

Timeliness is critical. Today's news should be relayed today and get it right the first time.

A. Timeliness

1. Need information as soon as possible

2. 4 p.m. west is 7 p.m. east

B. Getting right information

1. Give good specific information, recognizing "hot items". Call in immediate information; USA Today's phone number is 800-368-3024.

2. Cultivate local contacts including Red Cross and homeowners affected (provide phone numbers).

3. Press love advance on-hand material. Send it regularly. It may be used at a later time.

4. Local news is good.

C. Be sure to do good advance work

1. Where is the action (the fire and the firefighters)?

2. Who should the press contact to get "good" information (desire to warn public)?

3. What are the follow-up stories (days, years) that can be utilized by reporters?

II. Suzanne Lagoni - Regional Focus

A. Discussed first fire she covered as a TV news anchor - Pattee Canyon Fire, July, 1977.

1. Outlines problems from her perspective

a. No film crew available

b. 3:00 p.m. - only a few hours before she was to go on the air

c. Wanted to pinpoint area of danger

Workshop Report developed at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Jamie Haines is Director of Public Affairs and Public Education, National Fire Protection Association, Quincy, MA.

Steve Laursen is Forestry Specialist/Assistant Professor, Montana State University, Bozeman, MT.

d. Should she go out or stay at the station - where would she get the best information?

e. She got the run-around from fire folks

f. Started getting calls from AP and national TV networks

g. She needed to get on-air reports and finally did

B. By the next fire, the situation was much better

1. Coordinated agency effort - firefighting and media relations

2. Stations now call when events occur

3. Hot lines established and phone numbers distributed in advance

4. News about bad fire seasons distributed early

5. One agency takes control for public information on each fire

C. You have to realize first that there are different types of media people

1. Radio - they need a fast report on what's going on

a. Number of houses burned

b. Evacuations

c. Public alerts needed

2. Newspaper -

a. Because of deadlines they may have more time

b. More space to go further into story

c. Looking for features and side bar articles

d. Because reporters may have been in area longer, they may be better informed

3. TV and news photographers -

a. Always need more pictures and video footage

b. Reporters probably better understand situation

c. Problems with young, inexperienced reporters can require providing more background

D. Media Relations

1. The more information you give, the more good the interview can do

a. Important to get to know reporters from all media factions

b. Develop an ongoing media plan--it should be complete but flexible (for example, know reporters, but be prepared for newcomers)

c. Ensure safety of reporters (especially inexperienced)

d. Maintain social contacts and talk on phone even and especially when fires aren't burning

E. Media Relations Facilitation

1. Provide photos or footage

2. Provide opportunity for media to get photos

3. Tenet - Media will get stories and photos--help them tell your story

F. Q: Isn't it wise to train your reporters? (There is a need for training reporters to keep down excitement when interviewing.)

A: Yes, a news desk should keep contact with reporters and stress the point to keep calm.

Q: Some difficulty in dealing with the press exists because of the difference between image and accurate portrayal of the situation--when a bad portrayal is shown, image is eroded.

A. A good media plan should help resolve that. Advance work between agency and media really helps.

Comment: Because of inexperience of reporters, it is often a good idea for the agency to set up briefings prior to fire season with reporters.

Comment: Getting information out is the responsibility of the agency--do it when you have time - outside the fire season.

III. Beth Horn - Establishing Media Plan

Start with the understanding that no matter how much you plan, you may not have time to carry out plans to the letter - be flexible.

A. Objectives of Information Officer (IO)

1. Relieve pressure on other fire people

2. Maintain a central place for media information

3. Provide fire education/presentation information

4. Bridge between press and public

5. Accessible press center - phone lines (2) in/out

B. Media List

1. Keep up-to-date with media within state/region

2. Note deadlines and schedules

C. Media Relations

1. Call early to establish press briefing schedule

2. Allow lead time for reporters

3. Provide "quick bite" for press who call in

4. Keep an up-to-date list of "fire facts" for reference

5. Have a set of maps - state, highway, and fire

6. Be prepared to report expectations (prognosis) but don't give erroneous information!

D. Correct Information

1. Visit fire boss and strategy sessions

2. Make sure someone else in overhead is able to help with overflow of media

3. Human interest stories should be provided (for example, story about firefighter for local newspaper)

4. Provide stats about "airshow", "fireline", "chowline", etc.

E. Fire Information Plan - Pre-Crisis - Do in advance of fire season

1. Media contacts, local officials, and emergency services - who will contact them and when

2. Conduct education programs for people who might be affected by fire

F. Comment

1. If you have photos or file tapes, offer these to the media

2. Have statistical and other information at your fingertips

IV. Gladys Daines - Public Service

A. History

1. The Smokey Bear Program has been around since 1942.

2. Purpose - create and maintain public awareness

3. Message is not that all forest fires are bad, it is that people can and should prevent wildfires

B. Developing a public service campaign

1. Decide what focus will be and develop a plan including time needed for production, distribution, and placement

2. Develop print public service ads

a. Newspaper and magazines can use spots year around

b. Radio uses mostly when it is fire season

3. Develop a variety of PSA approaches to reach different audiences and tackle different problems

a. Geographical strata

b. Cultural strata

4. Send out advertising kits

C. Placing your PSAs

1. Have agency representatives go to media with kits

2. Make sure your campaign is launched to cover all the problem areas

3. Television and radio are interested in local PSAs with local information

a. Do good job in producing

b. Do good job in contacting

SESSION II: QUESTIONS, ANSWERS, AND COMMENTS

1. Comment: Session has concentrated on working with media during crisis. We need to develop

skills for working with media to promote fuel management/homesite protection as a necessary and regular activity.

2. Q: Talking about "giant" fires - small fires are a problem too - media doesn't cover small fires well. There was an incident where a reporter didn't know whose fire it was - went to residents. What should I do?

   A: Need to follow-up when erroneous information is published. Educate reporters on basics before crises. Also, provide demonstrations which illustrate all aspects of fire prevention/ suppression.

3. Q: How does Smokey Bear Program deal with urban interface?

   A: A print PSA has a rake graphic to brush dry shrubs with supporting copy.

4. Q: Can we expect the newspapers to pick up on the prevention theme (is it news)?

   A: It depends on how it is presented - and on the type of media you're using:

      1. Graphics

      2. Short messages linked to related "newsy" story

      3. Build story around children

      4. Graphics feature on weather page.

5. Q: How do we get the media out to cover what we think are important events?

   A: Know what day of the week media have staff available.

      Involve media in planning process from "day one".

      Be aware that everyone is trying to use the media to disseminate their message. (Align yourself with other groups to reduce the number of folks approaching media.)

      Do some research on the problems - put together a report, then take it to the media. Volunteer the information.

      If you get one media person interested, you can get other media factions interested in their story.

6. Comment: Ally yourself with other groups to reduce the number of folks approaching media (such as the Red Cross and Salvation Army).

7. Comment: New design calls for Incident Commanders to do a lot of dealing with media. Incident Officers come to the Incident Commander rather than Plans Chief now.

8. Comment: RE: Information Planning

   a. Get plans in written form to be given to other people on fire overhead that come in (not in your unit).

   b. IOs from other areas are reading information off stat sheet and should be doing more to help educate the media to issues.

   c. You need to be sensitive to the needs of the reporter.

9. Comment:

   a. You have to get new news to the media. Consider different story ideas such as:

      - reforestation after fires
      - new computer technologies
      - new ICS
      - how can homeowners fire-proof their homes

10. Comment: Another branch of media is magazines - magazines need lots of lead time, but are often interested in longer stories.

11. Q: Scanners can allow media and residents to get to the scene before firefighters. How do we get media to help let John Q. know that they are endangering theirs and others' lives?

    A: Make it clear what your priorities are in a situation.

       Get hold of local media and show them situations.

       Media and firefighters have some motivation behind their professions - they just need to understand each other better.

FACING HARSH REALITIES: STRATEGIC CONSIDERATIONS NECESSARY TO OBTAIN CONSENSUS IN METHODS OF PROTECTING INTERFACE PROPERTIES

Notes from Workshop No. 6
Workshop Leader: John Marker
Facilitator: Troy Kurth

Workshop Objectives and Expectations: Participants identified five objectives and expectations:

1. Develop Concerns and Issues
2. Strategies to Support Concerns and Issues
3. Values at Risk: Resources versus Property
4. Wildland and Rural Capability
5. Share the "Tools" of Activity

Participants were then divided into subgroups addressing topical items through three structured goals.

Topical

Resident
Business/Commercial
Government
Fire Agencies
Resource Managers
Visitors

Structured Goals

1. Strategies to support concerns and issues, and share the "tools" of activity
2. Values at risk: resources versus property
3. Wildland and rural capability

Workshop Report developed at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

John Marker is Director, Public Affairs, U.S. Department of Agriculture, Forest Service, Portland, OR.

Troy Kurth is Forester, Aviation and Fire Management, U.S. Department of Agriculture, Forest Service, Missoula, MT.

The following is the collective professional opinion concerning issues and concerns that will have to be revealed in order to obtain consensus and methods of protecting interface properties:

THE RESIDENT

The primary concern is safety for self, family, and neighbor.

Safety for lives.

The need to be able to self-defense their property.

The lack of awareness for a potential of an incident, or self-denial of it ever happening.

Protect the natural beauty around the home.

Homeowners must build a defensible property.

There is a lack of education of the public about the fire environment.

Protection of pets and animals.

Residents could take an active role in fire defense of his property.

How to protect oneself from a neighbor's negligence.

Accomplish some coordinated community planning.

Recognition of building codes.

There is a lack of regulation imposed on the homeowner.

The wide range of codes and enforcement/ inspections causes problems.

An aversion to regulations by people who live in rural areas. The need to be free, live where they want, choose their own destiny--fire protection agencies can only protect property up to limits set by local people.

Residents do not have realistic expectations, that is, what the protection is, what the fire will do, etc.

Insurance rates are manipulated. Rates should be high enough to make people protect their home.

BUSINESS/COMMERCIAL

Protection of life.

Rules on insurance vary from State to State.

Safety and protection of property.

Commercial development is directly related to expansion in areas. This may be in direct conflict with required codes and regulations for fire safe environments.

Expectations of the business community for fire protection and services, that is, how quick might a volunteer fire department respond.

Protection of investments in properties including resource based properties and the resource supply.

Commercial base which is formed on natural resource use may be the cause of growth and expansion of the wildland rural/urban interface (ski lifts, lake shore recreation resorts, etc.).

Awareness of zoning codes.

GOVERNMENT

The Land Use Plans dictate what is happening or should happen.

Ordinances: There is a need for more sterilized control. Need to protect development from its own future self-destruction--shake roofs, for example. "The purchaser automatically assumes the development is safely built and located." Protection means--protection from not information about. There is a distinct lack of communication between the groups: the owner (purchaser) and the developer and the Fire Department. The real estate salesperson does not say: "Now you understand this place may burn down." The cart is before the horse: The residences are built before adequate roads, protection, other essential services are provided. (By who?)

A better definition of responsibilities through the various levels of Government is needed. Government officials must realize this issue is one of their problems.

The Government sometimes is forced to do unrealistic things, like dropping retardant, just to show they are doing something.

The Government needs to be truthful with people, that is, "We cannot stop that fire." "It is beyond our capacity - our planning - our capability."

People in Government must be educated in procedures and understand their roles.

The "rubber meets the road at the local level."

We need a grass roots uprising to solve the problem.

Expand ICS to other agencies--include the sheriff, medical, other agencies on the incident.

There is a reluctance on the part of legislators to get tough. Can the Government take the lead, or must they wait for a disaster to generate the grass roots uprising?

What level of Government takes the lead? It will not be on the local level until a disaster occurs. National level needs to educate the Nation on disaster potential. Smokey should get involved for the long-haul resolution. The National program is only as strong as the local program. We also need the local quick fix. There is a need for public education in rural/urban interface areas to teach fire safety.

We need a "Fire Safe" program like conservation education program.

Need a "60 Minutes" on fire safety (lack of).

"They" are going to build, develop, and sell as much development and "they" can. "They" don't say a word to the purchaser about the risk and hazard--the bottom line is the buck.

My (resident) expectation from the Fire Department is not what I'm going to get. What you want me to do as a resident may not be realistic--you want me to clear 100 feet--I may now own 100 feet!

We have the technology. It is fragmented by layers of Government agencies.

Have the Fire departments critically looked at themselves lately? Are there things I can do? Are they always passing the total buck on to the residents and Government?

FIRE AGENCIES

We are starting to do more disaster drills that involve everyone.

Protection of lives, property, resources.

Pre-incident planning.

We are asked to be prepared outside of our normal fire season to meet needs elsewhere as well as interagency local needs.

Coordinated training programs--integrated purchasing, grant program, surplus program (State and Federal).

Use of public and industry liaison to use their resources.

Safety for firefighters--proper equipment for both structure and wildland fires.

Attention to laws and statutes.

Ability to provide an initial attack force.

RESOURCE MANAGERS

Get public involved beforehand.

Loss of winter range, trapping areas, wood, fiber production, timber.

Know and understand the long- and short-term value of resource.

Use of prescribed fire to enhance resources and lower hazard.

Do your political homework

Protection of watersheds, fisheries, and air quality.

A need for integrated planning and coordination between managers.

Use industries resources.

We usurp some of our program flexibility by tying into long-term goals and fail to respond to immediate needs.

VISITORS

We are all visitors.

GENERAL ISSUES AT LARGE

We have not yet faced what we are willing to risk or give up on some tough issues: property versus resource values.

Today, if you make a mistake, the public will eat your lunch.

I want a quick, fast answer and it isn't there. There is more work to be done.

Anticipated taking back more "tools"--some "how to's" not "shoulds".

We don't have it clearly cut and dried as to who's responsible for what.

The issues are too general, not specific--wanted to see methods discussed.

There is a frustration on how to reach the public with the message you have to give.

We (business) market a product and target the market. Maybe there are ways to meet this need such as community outreach programs (churches, schools, clubs) by your department. Go right to the source of the problem with your message.

Turf--structure versus wildland fire--this is a bullet that has not been bit.

Self-help--people have to get the knowledge--how do we get there?

We've got some information that has not been heard. "Fire services" have to start looking outward, not inward!

COLLECTIVE GROUP EXPERIENCE

Federal Forestry - State and Private

Federal Forestry - Fire, Washington, DC, Minnesota, Montana, Washington

Information Fire

Homeowner in fire environment

State Forestry - Fire (Washington, Wisconsin, Oregon)

Northwest Territory, Canada

Business person

Rancher - NE Wyoming

County Commissioner

County Fire Department (Washington, Oregon)

National Forest Supervisor (California)

State Fire Marshal (Oregon)

Fire Chief (Kananaskis, Alberta, Canada)

Forest Fire Management Officer

Logger/Engineer

SESSION 5

Bruce Coulter, Moderator
Colorado Forest Service
Fort Collins, Colorado

PLANNING FOR THE FUTURE:

HOW CAN WE BETTER DEAL WITH TODAY'S AND TOMORROW'S COMPLEXITIES?

M. Rupert Cutler, Ph.D.

ABSTRACT: Human population growth is the root cause of the escalation in the number of wildfires in rural residential areas. Adoption of growth management strategies such as land use controls, land acquisition, the timing and location of public facility improvements, and the use of tax and fee systems can be used to concentrate human settlements. In the long run, stabilization of the national population through changes in federal laws, including an immigration ceiling, will make the problem easier to solve.

INTRODUCTION

I feel like I've returned to the scene of the crime!

Session moderator Bruce Coulter noted that, a decade ago, I was the Assistant Secretary of Agriculture for Conservation, Research and Education, President Carter's appointee to provide policy direction to the Forest Service. On July 16, 1977, to be precise, I was standing on the Missoula airstrip, being briefed by Regional Forester Bob Torheim on Forest Service wildfire research and management programs.

"We're ready for anything," says Bob.

"Then what are you going to do about that fire in the canyon behind you?" says I.

At that point, half of those briefing me rushed off to assemble a team to fight the Pattee Canyon fire, in the mixed Douglas-fir-single family home forest type which surrounds this and so many other cities in the West.

The Pattee Canyon fire consumed six homes worth $330,000 and 1,200 acres of timber and brush. Suppression costs totalled over $300,000. And there I was, possibly keeping some of the fire staff here from their appointed rounds.

I'd hate to think that fire was staged for my benefit. The Forest Service does go to impressive lengths to impress new assistant secretaries with its expertise.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

M. Rupert Cutler is Executive Director, Population-Environment Balance, Inc., Washington, DC.

During that period, when I was in the Office of the Secretary, I used to reassure my Forest Service friends that I, too, began my career at a low federal grade level, in the field--that I knew what a Pulaski tool was and how to throw mineral soil on a fire with a lady shovel. In 1952 I was a smokechaser and lookout on the Sullivan Lake district of what was then called the Kaniksu forest in northeastern Washington and northern Idaho.

I have choked on smoke, and spent nights on the ground after putting out fires, trying to keep warm by revolving the body near the last still-burning log. I have great respect for firefighters.

We lived in northern Arizona for a while and spent our weekends on the national forests in that part of the region. From these and many other encounters since, I know the Interior West pretty well for a Midwesterner turned Easterner. To my way of thinking, there's no finer country.

But the character of the Interior West is changing rapidly, isn't it? Changing because its human population density is growing--a characteristic it shares with the rest of the country, except that the population is growing faster than average here.

THE U.S. POPULATION GROWTH RATE

We may not be living in a Third World country with a fertility rate of over 4 as in Kenya, but the theoretical doubling time for the U.S. population, at the rate at which we <u>are</u> growing is only 55 years.

As a matter of fact, it already has doubled in my lifetime of 54 years. The population of the United States--123 million when I was born in 1933--is 243 million today. It seems to be headed for the 300-million mark soon after the turn of the century . . . and 400 million people in the U.S. within the next century is within the realm of the possible, if not the desirable.

To take just one Interior West state as an example of what's happening--and may happen--regionally: The population of Colorado has more than tripled since I was born and more than doubled since I was calling in lightning strikes from the Little Snowy Top lookout tower. And we "ain't seen nuthin' yet": Department of Commerce projections show Colorado growing from 3-½ million today to 5-½ million within 40 years, or two generations.

Denver's population is four times what it was when I arrived on the scene, in the depths of the Great Depression. I'll bet the same could be said for most the cities each of you represent.

Did you know that the United States has the highest population growth rate in the industrialized world? That all but five states gained population in the last five years, with the Interior West states growing at a 5-to-17 percent rate over that period? That this growth has been concentrated in the suburban rings around our cities?

Perhaps you did know that it's in our western cities' suburbs where population growth has been the greatest. After all, one costly result of population growth-driven suburban sprawl--"the escalating problem of wildfires in wildland residential areas throughout the west"--is the reason we're here today.

But do you know the sources of those new residents and the consequent expansion of our urbanized areas, which is giving you fits because of the escalating wildfire problem?

Did you know that there were over 3.7 million births in the U.S. last year, as many as during the Baby Boom years? That one-half million of them were to teen-aged mothers? That, of the roughly two million immigrants who entered the U.S. to stay last year, about three-quarters entered illegally?

And were you aware that the "amnesty" provisions of the Immigration Reform Act of 1986 invite millions of illegal aliens to stay and to bring their families? When they are implemented, the annual flow of legal immigrants will top the one-million mark, unless a firm, overall immigration ceiling at the lower level is adopted soon.

I may have surprised some of you with my emphasis so far on population growth in this "planning for the future" message. You know I've spent most of my life fighting for wildlife and wilderness protection. But I have concluded--and I hope that, when I'm finished this morning, you'll agree--that we can make changes in buildings, landscapes, community design, and management of vegetation until we're blue in the face and we won't have addressed the root cause of residential-area wildfires, only their symptons, important as they are.

Their root cause is population growth.

THE SHORT ANSWER

Now here's my short answer to the specific question your program chairman posed to me, "How can we better deal with today's and tomorrow's complexitities?":

1. Use integrated federal-state-local land use planning at the county or multi-county level to encourage

   (a) clustered residential development and

   (b) preservation of open space.

Use zoning, growth boundaries, transferrable development rights, purchase of easements, or outright land acquistion to accomplish this.

2. Elect politicians with brains and guts enough to actively support state and federal laws which encourage sex education, easy availability of contraceptives and abortion services; discourage large families; prohibit government subsidy of urban sprawl; prohibit the hiring of illegal aliens; and limit immigration into this country.

LOCAL PLANNING

Let me give you local planners some specific suggestions:

Last year Population-Environment Balance conducted a nationwide inventory to determine where sophisticated techniques of local governance are being used to limit growth and which techniques are being used successfully. The results of our survey are contained between the covers of this booklet entitled" Community Responses of Population Growth and Environmental Stress."

The booklet sells for $5.00. I've brought a supply with me to give you on a first-come, first-served basis.

Here's what we found out. It relates directly to your interest in protecting people and homes from wildfire.

With the support of the David and Lucile Packard Foundation, and under the supervision of Robert J. Gray, who directed the well-publicized National Agricultural Lands Survey for the Carter Administration, BALANCE staff members called local planners in 1,500 cities and counties, to quiz them on the characteristics of their local land use planning programs.

Applying certain quality criteria to these data, we concluded that we had found 280 cities and counties with true growth management programs worthy of inclusion in our computerized national data base of local growth management strategies. Each community's mix of techniques is different.

The BALANCE survey grouped the 25 different local growth management techniques we discovered into four major categories:

1. Land use controls. Of the 280 programs covered by the inventory, all but two include some form of land use control such as zoning, the grandfather of all growth management devices.

2. Land acquisition. Absolute ownership of a parcel is one technique. Others involve acquisition of partial interests in real estate, the payment of compensation to property owners whose property has been "down-zoned" to such a degree

that its value is markedly impaired, and the imposition of restrictive covenants on land which has passed through community ownership.

3. Public facility improvements. Among the new techniques working their way into the planning ordinances of many communities are those which schedule the timing and/or location of public facility improvement as a way of regulating growth. Because most development depends in one way or another on public expenditures, long-range planning for sewer, water and highway construction can be an effective way to influence the rate, location and timing of growth.

4. Tax and fee systems. The use of taxes and fees is a relatively new development in growth management. They may take on added significance in the future as economic pressures force communities to locate new revenue sources to meet their growing budgetary demands, while curtailing the growth which adds inevitably to their economic burden.

The type of program selected and the specific techniques used vary from one region of the United States to another. Let me give you an idea of how this cuts:

Land use control is the principal growth management tool in the Northeast, with land acquisition and public facilities improvements also playing significant roles. Communities there also are adopting fees imposed on developers and other devices to shift the cost burden of new growth away from the public sector.

In the South, environmental controls are prominent. Concern for floodplain and ground water protection is obvious. Local programs in the North Central region emphasize agricultural land protection, environmental controls, and the timing of public facilities such as water and sewer.

The West yielded an abundance of growth management programs, including many innovative techniques that have little representation in other parts of the country. Land use controls are the major growth management technique here, together with the timing of public facilities. The growth boundary or urban limit is becoming an important element in the West.

Wouldn't growth boundaries help protect people and homes from wildfire?

The growth boundary establishes a line separating urban and rural areas. It is designed to protect open space and agricultural land. It defines the limit within which the full range of urban services will be provided. The purpose is to promote compact urban development within and adjacent to existing urban areas, insure efficient use of land resources, and facilitate least-cost provision of public services.

I was particularly interested to note that many communities have set specific goals to limit growth. Attempts to manage growth by placing upper limits on population, residential development, or commercial/industrial development appeared in 128 of the 280 documented programs. Twenty-four of the programs we identified include an overall limit on population. Sixty-six communities reported that limiting residential development was an objective of their program. Thirty-eight programs include a cap on commercial or industrial development.

And well they might decide to limit residential development. At least three studies I'm aware of--conducted by the President's Council on Environmental Quality, the American Farmland Trust, and now by Population-Environment Balance (in two booming counties in Maryland)--show that new subdivisions never pay for the public services they require.

The high cost of providing new residential developments with roads, water supply and sewage-treatment systems, schools, and school bus service always is subsidized by the pre-existing residents of a community. This subsidy escalates substantially when the new development occurs on large lots. When wells and septic systems fail, the cost of connecting these homes to public sewer and water--to end the groundwater pollution and public health problems so created--is extremely high.

MYTHS OF GROWTH

Incidentally, BALANCE recently published a one-page fact sheet called "The Myths of Growth" which might be of use to those of you interested in enlightening your constituencies regarding the downside of continuing residential growth in your communities. These are the myths we attempted to dispel:

Myth No. 1: "New development increases a community's tax base, spreads the tax burden among more people, and lowers everyone's individual tax rates." Fact: New residential development must be subsidized through higher taxes paid by all. The costs of new schools, roads, police and fire protection, water and sewer lines and other services will far exceed the tax income generated by the new housing development.

Myth No. 2: "Growth management programs cause land prices to escalate, making private homes more expensive." Fact: Most growth management programs streamline the permitting process by locating all agencies with which a developer must deal in one location. The review process is expedited. A well-devised growth management program stabilizes land prices because it eliminates the element of speculation, the driving force behind rising land prices in most urban regions.

Myth No. 3: "Growth management will increase the cost of public service such as water, sewers, and highways." Fact: Without a growth management program, sprawl, strip development, and leap-frog development occur, creating the need for enormously expensive improvements in public services. Growth management programs channel growth into those areas which have sufficient public service available, making them extremely cost-effective.

Myth No. 4: "Growth management programs are elitist because they exclude low-income families." Fact: Modern growth management programs make affordable housing an integral part of the community plan.

Finally, Myth No. 5: "If every community in the United States adopted a growth management plan, eventually there would be a housing shortage." A community which reaches its growth limit under a growth management plan would be no different than a desirable residential subdivision which is completely built out or an apartment complex in which all of the units have been rented. A person who wants to live in one of those locations must wait until a house or an apartment becomes available. This scenario is repeated every day across the country without oppressive results.

GROWTH MANAGEMENT CLEARINGHOUSE

Just to whet your appetite for more information from our Growth Management Clearinghouse--and you can call BALANCE's General Counsel, Gene Ruane, who once was a county planning commissioner himself, for the details--here's the complete list of 25 growth management techniques we discovered. They have been tried and tested and are available for your use in your communities to reduce the wildfire hazard, save working forests and keep taxes down.

Under "Land use controls" we found, in the order of their frequency: subdivision regulations; convential zoning; floodplain zoning; planned unit development; cluster zoning; critical area zoning; conditional zoning; non-exclusive agricultural zoning; bonus/incentive zoning; performance zoning; exclusive agricultural zoning; and building permit limitations.

Under the heading "land acquisition" we found: fee simple acquisition; conservation easements; advance site acquisitions; restrictive agreements; purchase of development rights; transfer of development rights; and land banking.

"Public facilities improvements" include capital improvement programming, development timing, and annexation.

"Tax and fee systems" mean that some communities are using development fees, urban/rural service area assessments, and/or land gain taxation to control their growth.

NATIONAL PLANNING: THE CONTEXT

The second part of my answer to the chairman's question, "How can we better deal with today's and tomorrow's complexities?" was: Stop U.S. population growth. That's the only way to take the pressure off your communities in the long run. That's not my idea; it was expressed by the Commission of Population Growth and the American Future, chaired by John D. Rockefeller 3rd, 15 years ago. The commission's lengthy final report concluded:

"The stabilization of our population would contribute significantly to the Nation's ability to solve its problems."

If we can't slow our population growth, this is what's in store for us: Our present demographic trajectory, with no population policy changes, will put our nation's population at between 270 and 300 million in the year 2000. That's between 30 and 60 million more people, most of them living in our already crowded existing metropolitan areas, all of them needing food, shelter, energy, and jobs. Our population could reach 400 million within the next century.

Let me appeal now to both halves of your brain, by showing a few slides prepared by the staff of American Demographics magazine:

1. U.S. Resident Population, 1980-2000. We think 265 million by the year 2000 is on the low side, and that 280 million will be closer to the mark, unless an immigration ceiling is adopted soon.

2. U.S. Population, 1980-2050. You can ignore the yellow line; zero immigration is not likely. Again, without a firm annual limit on immigration, we're looking at a U.S. population of over 350 million--100 million more than today--by the middle of the next century.

3. U.S. Household Growth. The rate of growth in households is much greater than the rate of population growth, meaning increased numbers of houses --accelerated urban sprawl. Just what you wanted to hear!

4. Population Change, 1980-1985. To quote our own BALANCE-data No. 22: "From 1980 to 1985 the population of the United States grew by 12.2 million people, an increase of 5.4 percent over 5 years. Although the growth is concentrated in the Southwest and Southeast, over the last five years, population has increased in every region of the U.S."

5. Projected Population Change, 1985-1995. The West will grow by 13 percent.

6. Ten Fastest Growing Metropolitan Areas, 1983-2005. Santa Fe is at the top followed by three metro areas in Florida, and then two in Texas.

7. Finally, Immigration to the U.S., 1950-1985. In 1985, says this graphic, 46 percent came from Asia, 37 percent from Latin America, and 11 percent from Europe. But at the April 1987 meeting of the Population Association of America, I learned that the most recent tabulation shows that half of recent immigrants are from Latin America, 29 percent were from Asia, and 21 percent were from Europe and Africa. Practically all of them gravitate to our big cities. One-third of the growth of U.S. metro areas is due to immigration.

NATIONAL PLANNING: THE AGENDA

Think ahead with me to the future, and ask yourself: Will we as a nation adopt a sound population policy, calling for a stabilized population,

to minimize costly congestion, keep resource demands in balance with supplies, and alleviate the boomtown, urban-sprawl pressures on our smaller cities?

Here is what the adoption of such a policy would mean:

1. No government incentives to have large families, including the unlimited income tax personal exemptions for dependents. That baby bonus would have to go.

2. No government subsidies for construction of new roads, airports, hospitals, sewer and water lines and other infrastructure outside already urbanized areas--subsidies which encourage urban sprawl onto farm and forest land, wetlands and flood plains.

3. Universal, effective public school sex education and population education from the earliest grades. Easy access by teenagers and others to birth control information, materials and services including affordable abortion services.

4. Real control of our international borders, to limit the number of immigrants coming in to the number of emigrants permanently leaving the country.

That, you'll agree, is a list of very difficult political objectives. But what is the alternative? Only continued growth.

CONCLUSION

Now that you know the facts--that hundreds of communities all over the country are successfully managing their growth; that our high fertility and immigration rates threaten to undo everything we put in place to direct growth and minimize land use conflicts--won't you help us accomplish two means of preparing for the future? They are:

1. Encourage local citizen volunteers to learn about and participate in local governance, to create an active constituency for good planning and local growth management in your communities; and

2. Encourage the associations you belong to to join with Population-Environment Balance in the campaign to win passage in the U.S. Congress of legislation to win a national policy of population stabilization, including the adoption of an annual immigration ceiling, and let your own representatives in Congress know you feel this way. The bills now pending before the Congress to take the necessary first steps are H.R. 2212 in the House and S. 1171 in the Senate.

On the basis of this two-pronged approach, progress can be made toward holding our population within the carrying capacities of both our communities and our nation. In the process, we can minimize the growth in wildfire risk at the urbanizing fringes of our rural communities.

Local growth management and national population stabilization, we must hope, are mature concepts ready for adoption. As Victor Hugo wrote,

> "Greater than the tread of mighty armies is an idea whose time has come."

Thank you.

CREATIVE TECHNIQUES FOR FIRE HAZARD PLANNING

Bruce A. Bugbee

ABSTRACT: Among today's planning tools, there exists attractive, cost-effective techniques which can be voluntarily implemented. When these techniques are employed by knowledgeable landowners, land use planners, and/or fire ecologists, risk of loss by fire can be reduced substantially. Both the landowner and the public benefit from these creative techniques for fire hazard planning.

INTRODUCTION

As our population, affluence, and mobility have increased, non-urban land has felt a new burden. Second home development, utility and transportation corridors, recreational developments, and recreational users have spread into lands with valuable wildlife habitat, open space, and agricultural production. Such land can be intolerant to much development, and substantial hazards exist to people who use those areas. Development in floodplains, on unstable slopes, and in frequent fire zones are examples. In dealing with fire hazard, there are two separate issues to resolve: 1) How to avoid building in rural areas which have high fire potential; and 2) if building is done, how to build in ways which reduce loss by fire.

In order to succeed at these tasks, some assumptions are necessary. These are:

1) Fire ecologists can and will identify areas of high fire risk.

2) Once such areas are identified, effective management techniques can be developed. These include forest and range harvest, prescribed burning, residential construction design, site preparation and maintenance, road design, emergency equipment access, escape routes, wildlife management, and infestation of insects and disease.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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3) Most rural areas have few, if any, regulations regarding fire prevention. Regulatory techniques such as subdivision and zoning tend to do only part of the job. They often address how to build but not the environmental impact of such building, nor the risks associated with it.

4) Implementation of appropriate techniques requires the cooperation of a variety of people. Among these are fire ecologists, fire fighters, land use planners, public land managers, and private landowners.

To address fire hazard, a example can be made of other land use planning problems in which the objective is to limit or prohibit residential development without regulation and to do it in ways which protect wildlife habitat, wetlands, open space, recreation areas, and/or municipal water supplies. The solutions to those problems are relatively simple: either buy the property or acquire limited interests in the property sufficient to accomplish the objective. Cooperation on the landowner's part is voluntary.

Protecting all high fire hazard zones in rural areas is an ambitious and intimidating task. Should all privately-owned rural lands be bought and owned by the public? Probably not. However, let us assume that something between 1% and 10% of the privately-owned rural landscape is the area of most critical fire concern. These would be areas of the urban-rural interface, of high recreation use, as well as areas of rapid accumulation of volatile fuels. For these areas, land use planning techniques used with the full cooperation of the landowner can be an excellent solution to high fire hazard problems.

A brief review our our land ownership system is necessary to understand how such voluntary land conservation devices work. Our system of land ownership operates on two levels. One is abstract, and the other is tangible.

Our legal system recognizes an individual's right to own land. Ownership includes possession of whatever is over, under, and on a given piece of property. Typical rights of ownership include

minerals, access, water, timber, agricultural use, industrial use, and residential use. The property's size, shape, location, scarcity, relation to surrounding land, soil, vegetation, slope, water availability, wildlife, visibility to others, and history of use are tangible aspects of land ownership. These qualities shape legal rights of use. The right of ownership also carries with it the right to convey property or property rights to others. Conveyance may be made by gift, sale, or will.

Our legal system also provides for the well-being of the community as well as the individual. Our society believes the exercise of individual rights ought not harm other persons' rights. To protect against such harm, our society has provided us with what our Constitution refers to as "police power authority." Police power authority is the base from which grows regulation of subdivision, zoning, and building codes.

Historically, the public has decided there are certain lands which should be publicly-owned, such as national forests, parks, game refuges, and wilderness. The public has also decided that air, water, and wildlife belong to everyone. Some have suggested the public should have an interest in how individual landowners make decisions relating to fire hazard reduction. However, that which the public owns and that which the public values are not always the same. Sufficient motivation is essential for property ownership to change. Voluntary land conservation techniques are built upon motives and incentives which are beneficial to both the landowner and the public.

All voluntary techniques require the free consent of both parties to the transaction. Should the parties fail to reach agreement, no transaction takes place. Therefore, substantial motivation of the parties is a key ingredient to a successful transaction. Substantial motivation can be protection of the landowner's traditional life style from irresponsible public use, land trades which make management more efficient, or some financial compensation.

The techniques described in the following text have been developed primarily for preservation of wildlife habitat and open space. They are usually directed toward maintaining historic, agricultural land uses and preventing conversion of rural land to urban uses. Consequently, some of these strategies can be applied to meet fire hazard planning objectives.

FEE AND LESS-THAN-FEE CONVEYANCES

Voluntary techniques for land conservation generally deal with two types of property interests, fee ownership and less-than-fee ownership.

Fee Conveyances

There are some circumstances which require acquisition of outright ownership of the full "fee" title for conservation of the property. Generally, fee ownership of a particular property is necessary when public values, including fire hazard reduction, are complex and require substantial management control.

Areas considered for fee ownership include not only habitats for rare and endangered species, but intensive public use areas, such as campgrounds and picnic areas, sites for public buildings, and historic sites which require specialized management to preserve the historic character. Also included are private inholdings within public lands committed to special mangement and within which privates uses of any kind would be incompatible. Fire hazard areas suitable for public ownership might include high hazard areas requiring regular and substantial fuels management, as well as private lands surrounded by public lands with substantial fire hazard risk.

Less-than-Fee Conveyances

Conservation Easements--The device which has the greatest potential for fire hazard management is partial public ownership, or a "less-than-fee" conveyance. A conservation easement is an example of a less-than-fee device. Most of the rights of ownership remain with the landowner while limited rights, such as the right to develop property, are conveyed to a public or non-profit conservation organization. The property remains on the tax rolls and under management by the private landowner. Public access may or may not be part of such an agreement. Emergency vehicle and fire management access can be part of such an agreement.

Conservation easements reflect common goals shared by both parties to the agreement. Each conservation easement is different as to which rights will be conveyed because each easement reflects the significant conservation values found on the particular property for which it was written. In Montana, Conservation easements are recognized by State law (76-6-101, et seq. MCA). Federal regulations provide that donations of perpetual conservation easements can qualify grantors for certain tax advantages.

Reg. Sec. 1.170A-14(d)(4)(i)

(4) Preservation of open space--(i) In general. The donation of a qualified real property interest to preserve open space (including farmland and forest land) will meet the conservation purposes test of this section if such preservation is--

(A) Pursuant to a clearly delineated federal, state, or local governmental conservation policy and will yield a significant public benefit, or,
(B) For the scenic enjoyment of the general public and will yield a significant public benefit.

Conservation easements are best used to protect significant public values on private land when public values have coexisted with historic and present private land use, and the owner wants to retain the land. In these situations, maintenance of conservation values may be possible by simply continuing the historic range of compatible uses of the land. Fire hazard reduction and fuels management can be specific objectives. No public access is necessary in that situation. Conservation easements prohibit the conversion of the property to new, incompatible uses, such as subdivision development on elk winter range or high fire risk areas.

Other types of less-than fee conveyances include:

Public Access Easements--A public access easement conveys the right of public access. That access may be specifically designated, such as a road access, fire control access, fire break roads, trail access, access for parking, or boat access. The access agreement may be for a set period of time (term agreement) or in perpetuity (perpetual easement.)

Term Agreements--In some circumstances, either the landowner or the public agency may not be prepared to enter into a perpetual conservation easement or public access easement. Also, certain shared responsibilities are oriented to short term management concerns rather than to permanent commitments of land use. For example, a short-term agreement may be appropriate for an experimental prescribed burning or fuel reduction program.

A term agreement can be set up for a certain number of years. This term can be whatever the landowner and the agency agree to. However, generally no tax incentives are available. Term agreements may be helpful in situations when larger, undeveloped properties are adjacent to developing areas and the landowner has no immediate plans for development.

Term agreements also can be used to allow limited public access to a stream or park Specific areas can be designated for campfires and high fuel hazard areas can be avoided. Time of year of access can also be controlled. Local, State, and Federal agencies can provide support for seasonal enforcement. If the public is not responsible in its use, the agreement can be terminated by the landowners.

CHARACTERISTICS OF FEE AND LESS-THAN FEE EASEMENTS

Less-than-Fee Ownership	Fee Ownership
Partial legal interest: only those rights necessary to protect conservation values	Full-right title and interest
Lower cost acquisition	Higher cost acquisition
Lower management costs: landowner responsibility	Higher management costs: public responsibility
Widespread application	Limited application due to economic and political constraints
Land stays on tax rolls	Land removed from tax rolls
Perpetuates historic (mostly agricultural/silvicultural land uses/lifestyles	Can change historic (agricultural/silvicultural) land use to intensive public uses
Encourages sense of individual responsibility to community	Encourages dependence on government for solutions

METHODS OF COMPENSATION

Conservation Bonds

State and local government have the authority to initiate bonds to raise money for conservation land acquisitions. These bonds can be created only by majority public vote. In 1981, the City of Missoula received voter approval for a $500,000 bond. The money was designated for acquisition of downtown riverfront and scenic open space on nearby Mount Jumbo and Mount Sentinel. Mount Sentinel has had major fires almost every year in recent history. A conservation easement purchased with conservation bond dollars has prevented development forever. Negotiations for acquisition of appropriate parcels were handled by existing City staff and assisted by a citizen review board.

Cooperative Management Districts

Cooperative Management Districts (CMDs) define large areas of conservation, open space, and recreation needs and secure property rights to provide for those needs. Local, state, and federal governments can cooperate to designate CMDs for large regions. With proper planning, fire hazard reduction and development conflict avoidance can be design components of these sysems. The Greater Yellowstone Ecosystem is an area currently under consideration for a Cooperative Management Distric, With CMDs, Park dedications from subdivision development could be accepted by local government only in areas designated for open space and recreation. Subdivision developers could be encouraged to purchase pre-designated areas to satisfy the park and open space dedication requirements of their subdivisions. In areas of compatible historic use by private landowners, open space could continue to be used for compatible agricultural or forestry purposes. Private ownership could be maintained subject to conservation easements.

Exchanges

Exchanges can be used to consolidate public land holdings and prevent development in high fire risk areas. The objective of a land exchange is to find two parcels of land owned by parties who have equally strong desires to possess the land of the other. For the private landowner, compensation occurs by means of the land he acquires.

There is no guarantee of success when an exchange is initiated. There is a risk that, as the process develops, either of the parties will become disinterested or conclude there is inequity in the exchange and terminate the process. Exchanges can take a substantial amount of time and can involve a variety of financial and legal advisors.

When government lands are involved in an exchange, the public's interest in the trade lands must be protected. Public support is required for the exchange to proceed. Acquisition of the private lands must also be in the public's interest. Environmental assessments, appraisals of land values, and public hearings are prerequisites for such exchanges to take place. Therefore, land exchanges should be considered only when the private lands have sufficiently high priority to warrant the expenditure of public resources without guarantee of success.

Several land exchanges have occurred in Missoula County in its recent history. These exchanges have been successful in acquiring high priority private lands and therefore preventing development in high fire risk areas. One example of such an exchange occurred in the Rattlesnake National Recreation Area and Wilderness between the Forest Service and Montana Power Company. 21,000 acres of Montana Power Company land existed as a checkerboard inholding of prime subdivision land beginning on the edge of existing suburban development. Subdivision development in this pattern could have been disasterous for future residents of the area in the event of fire. Both wild fires and prescribed burns have occurred in this area since the exchange was completed.

Design Solutions

A design solution is structured to parallel a comprehensive plan. A careful resource and development analysis is prepared for the landowner's property. This analysis results in clear definition of where high priority public values are located, how they can be preserved, as well as where and how the landowner could pursue other land use options (such as limited development) in a manner compatible with the public values. The analysis can include components such as emergency equipment access, controlled areas for open fires, homesite location controls, and fuel reduction programs.

If areas of the property are found which are suitable for intensive or limited development, and such development is compatible with the maintenance of conservation and fire planning concerns, the design solution forms the basis for the local government and the landowner to enter into an agreement. A conservation easement or land conveyance is designed and prepared for implementation at the

time the development decision is made. The ability to develop land in a limited area, combined with the income tax deduction made available by the easement, may maximize return to the landowner while minimizing the area needed for development. The use of tax incentives requires careful coordination with the landowner's professional legal and tax advisers.

CASE STUDY:

LESS-THAN-FEE CONVEYANCE -- CONSERVATION EASEMENT

Subject Property: Western Montana's Blackfoot River Conservation Easement Program

Situation: In the early 1970s, water-related recreation use on the Blackfoot River was increasing dramatically. With increase in use came increase in conflicts between private landowners and public recreationists. Littering, trespass, vandalism, and fires caused deteriorating relationships between recreationists and landowners.

Parties Involved: Several private landowners, recreation user group representatives, Lubrecht Forest, Montana Department of Fish, Wildlife and Parks, Missoula County, and The Nature Conservancy.

Choices:	Consequences:
Do Nothing	Landowner-recreationist conflicts would continue to increase; discouraged landowners would sell out to recreation subdivision interests; river access would become even more restricted, and high recreation qualities were likely to be lost
Zoning/Subdivision Regulations	Highly unpopular with landowners; if successful would allow changes from larger farm and ranch tracts to 20-40 acre parcels with occasional sales which could reduce lot size further
Establish Wild and Scenic River	Locally unpopular; high public expense of buy-out; long implementation period allowing conversion of land in the interim; reduce private property tax base
Reach Agreement among Landowners to Maintain Traditional Land Uses and Allow Responsible Public Use	Limit conversion of traditional land uses; allow responsible public use; some public expenditure to assist with river corridor management; landowners retain control of their property

Decision: Establish a voluntary conservation easement program and negotiate a term public access agreement

Results: Approximately 5,000-6,000 acres under permanent conservation easements protecting several miles of Blackfoot River frontage in traditional agricultural and timber land uses. Public access agreements negotiated separately for approximately 26 miles of Blackfoot River; almost total elimination of man-caused wild fires.

SUMMARY

In land conservation, the most common form of compensation is personal satisfaction of the landowner. Most rural landowners choose their lifestyles because they enjoy open spaces, wildlife, recreation, and/or working with the land. They would also like to do this safely. Local government is in a unique position to support the continuation of such values and provide safety. Such support, in whatever form it takes, can be compensation. Fire planning officials can work with State and Federal agency conservation lands acquisition programs to integrate local conservation objectives with fire hazard reduction.

There are a number of voluntary strategies which have accomplished major conservation goals which aid in fire hazard reduction. Many organizations and individuals are able and willing to help. Federal and State governments have been actively acquiring or trading properties for public purposes for a long time. National nonprofit conservation organizations such as The Nature Conservancy and the Trust for Public Land have been extremely effective.

In the 1985 issue of Land Trust Exchange, a journal reporting land trust activities nationally, survey results were presented on conservation easement use in the United States. As of that year, some 1,780,000 acres of land had been protected through the use of conservation easements. Conservation easements are found in nearly every state. There are some 500 organizations and government agencies which hold conservation easements in the U.S. 146 of these are county governments.

On a national scale, the prospect of land acquisition for fire hazard reduction is challenging if not intimidating. Those interested in protecting valuable areas of wildlife habitat, open space, and recreational resources have faced similarly intimidating work. However, during the last two decades, professionals in those areas have met that challenge with surprising success. Their successes have also meant, in many instances, prevention of future conflicts between development and wildfire.

The idea that fire is a part of the ecosystem's health is not surprising to those who work with environmental concerns. The idea that planning should purposefully incorporate strategies for fire hazard risk reduction is new. Federal laws which authorize purchases of land and facilitate charitable contribution treatment for donations of land in conservation easements can easily be interpreted to include public policies specifically designed for fire hazard reduction. In this instance, being creative means borrowing effective land conservation technology and making it work to reduce fire hazard, too.

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COUNTY LAND USE PLANNING, HOW CAN PLANNERS HELP THE FIRE SERVICES IN PROTECTING HOMES FROM WILDFIRE

Guy R. Groves

ABSTRACT: In Jefferson County we have established a procedure that is being implemented now that addresses the issue of wildfire at the development process. As a part of the development process we require that, where a hazard exists, a forest management plan be implemented prior to the conveyance of property ownership or just prior to building. A building permit will not be issued until a forest management plan is completed. Implementing this procedure has resulted in better relationships between Jefferson county, the Colorado State Forest Service, and local fire protection districts.

INTRODUCTION

The basic objective for local government is: "to protect the health, safety, and welfare of its citizens." It is this objective that gives rise to all the functions / services provided and managed by local government, such as land use planning. Planning responsibilities include: develop master plans, develop zoning ordinances, reviewing development proposals, and issuing building permits. In addition to these "chartered activities", typically required by statute, there are additional activities that exist as "functional" requirements: administration, information dissemination, education, facilitation, and research.

It is obvious that wildfires are a "public health, safety, and welfare" issue, and therefore can be considered as an issue that local government can take an active role in managing. It can be considered within any of the processes performed by a planning department. It is however, one of many issues that must be considered in the development process. Other issues include: transportation; availability of water; sewer, fire, police and other services; wildlife; visual impacts; historic resources; geologic hazards; flood hazards; and other environmental concerns.

The extent to which wildfire is considered depends upon the following: 1) Is wildfire acknowledged as a hazard (issue) at all, or is it ignored? 2) Is there sufficient information and understanding about the problem to include it as a consideration in the development process? 3) Is there a procedure and the appropriate personnel to implement wildfire hazard concerns? 4) Is there political support to manage the problem and what weight does it carry in relation to the other issues that must be addressed?

Wildfire is frequently acknowledged as an issue to be addressed in the planning processes. The exposure this issue has received in the past few years has increased dramatically. Some ten years ago, in Colorado, this issue was officially recognized by the state legislature. At that time there was a land use bill approved that required local governments to identify and manage "areas of state concern", one of which was wildfire hazards. Although the bill may be criticized for not providing good implementation tools or enough authority, it did have some very positive effects. First, it recognized and legitimized many issues that prior to that time were not properly considered in the land use decision process. Second, it provided funds to local governments to identify and develop management strategies for areas of state concern. Since this time there has been a national trend that has recognized wildfires as a growing land use concern. This trend started in areas that had serious wildfire hazard concerns, such as California, and is also exhibited by this and other conferences addressing wildfire hazards.

More recently there has been a greater amount of information and experience with managing wildfire hazard in the development process. There is still a problem with distribution of the information among fire professionals and planners. There is a need for more information sharing and cross training so that planners are more aware of fire protection, and fire protection entities are more aware of the local planning process.

It is probably safe to say that most planning departments don't have professional foresters or a natural resource specialist on staff to help them. This deficiency requires that they obtain resources from outside their organization to help them address wildfire hazards.

More importantly, the issue is not in the public forefront. Many people who move to the intermountain west are unaware of basic issues such as how they get their water (well versus public supply) and how services are provided. They probably have never heard of "geologic hazards" or "wildfire hazards." The greatest obstacle to overcome can be this ignorance among the general public.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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Although there is support and awareness within the professional communities, general public and political unawareness remains. Even where there is an awareness there is often the attitude that "it won't happen to me." Unfortunately, statistically they are right, the odds are (if you're a gambling person) that "it won't happen to me." The corollary, that is only discovered when it happens, is "To those that it happens to, it happens 100 percent."

Culturally there is a dynamic that suppresses the issue of wildfire hazards importance. The more frequently an issue is raised through occurrence and experience the more public attention and political weight it carries. The most frequent top issue in local governments is the condition of local roads because of their high profile. When roads are in bad shape local officials hear about it from the public on a daily basis because: 1) we experience the problem first hand, and 2) we all use our roads with a high degree of frequency, many times daily.

On the other hand, we typically hear about wildfire hazards on the news, and most of us don't experience them. Since they only occur for a short duration over the year, the frequency of exposure to the issue is low.

WILDFIRE HAZARDS & PLANNING

Historic Perspective

The methods used to manage for wildfire hazards in Jefferson County have evolved incrementally over a number of years. With the start of the House Bill 1041 program to identify areas of state interest, Jefferson County seized the opportunity to leverage its capabilities. The county planning department was in the process of developing a geographic information/modeling system to be used for plan development and development review. We applied for and received funds from the state that helped us to continue development of the automated system and collect resource information about the county such as vegetation, surface material, geology, and a host of other issues.

We were starting a "master planning" process for the county of which wildfire would be a criteria used to consider the suitability of a site for various forms of development. At the same time, also as a response to HB 1041, the Colorado State Forest Service started to map wildfire hazards for counties. Jefferson was the first county mapped but the time and resources to code the data into the automated system used for plan development were not available. As an alternative we interpreted from other information: vegetation and slope, using the latest version of the National Fire Danger Rating System - 1978 along with NOAA climate data and local Fire Weather Data available from the U.S. Forest Service to identify hazard levels for the county land use plan.

The bill also required that the county adopt a strategy to manage the areas of state concern. Since we were also in the process of identifying geologic hazards we decided to leverage our efforts by employing the same strategy for both issues. Our management strategy was to develop a Wildfire Hazard Overlay Zone District using the Colorado State Forest Service wildfire maps to identify hazard areas.

We established a Wildfire Hazard Overlay Zone district in the zoning regulations and outlined the process to be used. In prototyping the process we encountered some serious problems. To implement the zone districts we would naturally have to perform county initiated rezoning of all areas identified as a wildfire hazard where we wanted to ensure that mitigation would occur. To perform the rezonings would require that the planning department:

1) Obtain a legal description of each hazard area.
2) Post each area with signs that were easily viewed by the public.
3) Post public notices and descriptions in the local newspaper.
4) Notify all property owners within and adjacent to the areas proposed for overlay zoning.
5) Hold public hearings on the zonings.
6) Draw and adopt a map of those sites that were successfully overlay zoned.

Any entity rezoning property must go through this process. The problems presented with rezoning this many areas of the county in mass presented many difficulties. First there was the cost associated with obtaining legal descriptions for each hazard area. At the time we produced legal descriptions by digitizing from 1:24000 USGS quad. maps, a costly process in 1976 and 1977. Legal descriptions produced by this process were of little to no value given the map scale used and geodetic control. However, it met the legal requirement at the time. Next there was the issue of posting all the sites. Each site would have to be identified on the ground and posted with a standard rezoning sign. In addition, areas not easily visible from a road would also have to be posted along the road to adequately inform the public of the proposed action. Finally there was the problem of notifying all the property owners within and adjacent to the hazards as to the proposed overlay zonings. This was assessed to be a task that the county physically just could not perform, nor afford. The county simply didn't have the capability to perform these tasks within reasonable means. It should be mentioned that with the advent of more sophisticated Geographic Information Systems many of these tasks can now be performed quite reasonably. The problem would continue to be the availability of resources and funds for such a program. The "coup de grace" was the issue of what the county would do over time as the boundaries of the hazard areas change. Due to the dynamic nature of the environment, the process would be continuous as hazard areas changed. If we couldn't reasonably accomplish the first overlay zoning we certainly couldn't maintain any changes in the overlay districts.

As a result the "Wildfire Hazard Overlay Zone" districts were abandoned as a method to manage this issue. Instead we adopted a procedural guide where all rezonings, and platting activities would be referred to the Colorado State Forest Service for review and comment, specifically for wildfire hazards. At first they were handled as comments from a referral agency, since the Colorado State Forest Service doesn't have any regulatory authority it had to rely on the county to implement its recommendations. As time went by the county commissioners' confidence in staff and

the Colorado State Forest Service increased and the planning department became more effective at selling its positions regarding wildfire hazards.

Currently it is common practice for the planning department to have wildfire hazard mitigation as written restrictions on subdivisions of land in the development review process.

As a result of the department's effectiveness in obtaining written restrictions regarding wildfire hazards, the development community has been more receptive to utilize the Colorado State Forest Service for forest management of properties prior to their submission of plat proposals. This has allowed us to implement wildfire hazard mitigation and improve overall forest management.

Comprehensive land use plans

Land use plans, master plans, or comprehensive land use plans are product labels used to describe a responsibility of local government to designate acceptable land uses throughout its jurisdiction. Its purpose is to describe a desirable pattern of land use activities that ensure the publics "health, safety, and welfare." To do this, it must consider such things as: current uses, population needs, land capability, and provision of public services such as water, sewer, police, and fire protection.

Within a master plan, the presence of various environmental, demographic, infrastructure, and political conditions determine basic suitability of land parcels for various uses. Again, wildfire is one of many issues in determining the suitability of land for particular uses.

Typically, a master plan results in a map that describes acceptable land uses for particular areas of a community and illustrates the desired pattern of the uses across the community. The master plan map is a synthesis of the policies that determine land use suitability. To include an issue, the features must be mapped and policy must be developed to determine the effect of the feature on a particular forms of development.

The plan development process in Jefferson County is a three tiered structure. We have a Jefferson County General Land Use Plan, special land use plans, and community plans. The three types of plans are used to balance our resources to: 1) cover the entire counties land use plan needs, 2) provide special plans that address specific land uses such as landfills, gravel mining, and communications towers, and 3) provide plans that meet the specific needs of small communities.

The issue of wildfire hazards is incorporated into all three of these plan development efforts. In the General Land Use Plan, policy is incorporated that can be applied throughout the county. In special land use plans, policies are incorporated that address the specific land use. In community plans, the policies address wildfire conditions that are unique to that community. In applying the plans during the rezoning process special land use plans and community plans take precedence over the General Land Use Plan.

The plans give policy that are to be used in the approval or denial of land use changes. Each policy area gives the suitability for land use activities for each issue. A land use pattern map is available that shows a synthesis of the policies and provides guidelines for the future development of the area. In most cases the land use pattern map depicts a range of acceptable land use activities, not single specific land uses. Mapped base data is available to determine what the specific issues and impacts are, and where they are located.

Zoning

Local government has been given the responsibility of "zoning" land. Zoning identifies the basic type and intensity of land use that is acceptable. Types of land use include: agricultural, residential, commercial, office, and industrial. Intensity is a description of the quantity of development or activity, such as the number of residential units per acre, or the number of square feet of commercial per acre along with listings of permitted activities, and some basic "building envelope" constraints such as set backs.

It is possible to manage wildfire hazards through zoning. One approach is to create "overlay zone districts" for wildfire hazard areas. This technique is frequently used to restrict zoning rights where hazards such as flooding or subsidence might occur. The problem with this approach is that most hazards such as floodplains and subsidence are relatively static, they don't change significantly over time, and the areas are well definable. This is not the case with wildfire hazards. Over the course of a few years the bounds of a hazard area can change significantly. The process of maintaining an accurate, up-to-date map, and conducting the process of rezoning the overlay areas would stress most planning departments far beyond their capacities. In addition, the bounds of a wildfire hazard are not as well defined as, say, a floodplain. Legally it is feasible; functionally, it may be unreasonable to actually perform the tasks required to maintain and manage the system as discussed earlier.

In Jefferson County wildfire is considered in the zoning process through application of the appropriate land use plan. At rezoning it is determined if the proposed use is acceptable given all issues, wildfire being one. In many instances a "Planned Development" approach is recommended so that a greater definition of the desired use is made. It is also possible to define the major form of the development without requiring detailed lot or building placement. Although wildfire is considered there are no restrictions or requirements made at rezoning. The result is that the applicant is put on notice that this is an issue that will be addressed at the time of platting.

Development Review

The development review process involves the subdivision of large land parcels into smaller parcels, referred to as platting. The small lots or individual parcels are typically intended to be built on. It is at this step that a land use proposal must show the location of roads, lots, public areas, easements, utilities etc. This is typically where local governments require improvements to roads, dedications for schools and parks, use restrictions, and performance guarantees. The platting or development review process begins when a land owner submits a detailed development plan for a parcel. The local planning authority reviews the proposal, obtains referrals from other entities such as health, transportation, and other departments at the local and state levels. The local planning authority then presents the positive and negative impacts of the proposed use to local decision makers. With this and public comment a final position is negotiated. As a result of the platting process, a detailed commitment as to the minimum form of the development is made between the local jurisdiction and the property developer.

It is a frequent practice to place "restrictions" on a plat. That is the local governing entity may require certain site improvements prior to sale of any parcels. The most typical restrictions are usually landscaping and road improvements. A restriction might also require that a developer "mitigate wildfire hazard areas."

The advantage of this is that the developer can be required to develop and implement a forest/range management plan that mitigates the wildfire hazard prior to construction. Depending upon how it is designed and implemented, it also possible to manage the resource for other factors such as visual impact, wildlife impact, ground water, and other concerns associated with any forest/range management plan. This not only mitigates wildfire hazards, but reduces the overall impact of development on the environment and increases property values.

Disadvantages of this system are that it requires additional resources with the proper expertise to review and inspect forest management plans. It requires additional costs to develop properties which are eventually absorbed by the consumer through higher land costs. Resource are managed at one point in time, during the development process. There is no guarantee that the consumers, such as new home owners, will properly maintain the sites and prevent the hazard from recurring. Finally, it is implementing forest management on relatively small parcels of land. Adjacent parcels might still present hazards since they are not being managed.

In Jefferson County the Colorado State Forest Service is sent a referral on all cases in the rural areas of the county, where wildfire hazard is a concern. Currently there is an informal agreement between the county and the Colorado State Forest Service regarding their referral on wildfire hazards; that is, the county has no obligation or contractual agreement to implement their recommendations. However, the department relies on them to comment on the presence of wildfire hazards and their recommended mitigation action. Recommendations from the Colorado State Forest Service have been implemented in the form of written restriction on the plat, when a hazard is present. The typical restriction requires that a forest management plan be completed, inspected by the Colorado State Forest Service and a letter of compliance received by the county before property is sold or building permits issued. The restriction can be stated in two ways that have a subtle but significant difference. First, the restriction can require that the forest management plan be conducted prior to the sale of property or issuance of a building permit. Second, it might require that the forest management plan must be completed prior to issuance of a building permit.

The first option requires that the subdivider of the land perform the necessary forest management prior to conveying ownership of the property. A benefit of this is that the developer must implement a forest management plan that covers the entire property, including all of its lots. The disadvantage is that it cannot account for special management practices to be employed around homes because the building sites are unknown.

The second option only requires that the management plan be completed prior to issuance of a building permit. Land can be conveyed to a new owner and it becomes incumbent upon the new owner to complete a forest management plan prior to issuance of a building permit. The advantage of this is that the management occurs very close to the time of construction, and can incorporate concerns related to siting the structure. The disadvantage is that typically very small parcels are managed at any one time, and the burden is passed from the subdivider to the new owner.

Building Permits

Most planning departments, through the management of zoning, are the first step in acquiring a building permit. Prior to issuance of a building permit an applicant is required to visit the zoning department to ensure that the parcel is legal, the zoning is correct for the proposed building, and that all conditions of the platting process have been met. After meeting these tests the applicant can then get a building permit, typically from the "building department" that reviews construction plans to ensure that the built structure conforms to local building codes.

Although no wildfire management occurs at this time it is a critical inspection phase for Jefferson County. If there were a restriction on the plat, requiring the mitigation of wildfire hazards, then no building permit could be issued until such condition had been met. This process requires that an inspection occur sometime after mitigation has been completed and prior to the sales of properties or application for a building permit.

Information & Education

As a result of providing public services it is necessary that a planning department provide information and education services to the general public, building community, and local politicians. The degree to which this is

performed can vary greatly from one community to the next. In any event, the basic task of providing information about the local process, and educating the public and its own employees is essential to implementing any process.

In some cases information and education are becoming primary products for planning departments. There is a trend towards seeking higher degrees of public involvement in development of land use plans, regulations, and land use decisions. Planning departments have the attention of many people. By properly directing this attention it is possible to impress the importance of wildfire hazards on the general public, development community, and local politicians.

The process of education is employed most frequently at the community level. This occurs most extensively in the development of community plans. When a community is organized, one of the first tasks is to review existing policies and identify those policy areas that the community plan should focus on. In the mountain area of Jefferson County, one of those concerns has always been wildfire hazards. Presentations by staff, local experts, and the Colorado State Forest Service serve as educational platforms for the public. In addition, general public meetings (show and tell forums) allow us to give greater public exposure to pertinent issues. One of the most effective tools has been to let community members make the presentations and talk to the public. They seem to have greater success than we as professionals have at convincing their neighbors to be concerned about specific hazards and issues.

WILDFIRE HAZARDS AND PLANNING ISSUES

There is room for enhancements to the current system. In making any changes or developing a system from scratch, there are a number of concerns that need to be discussed. Some of them define new program objectives, others define the operating environment. An understanding of both are essential to implementing any new strategies.

Resources

In Jefferson County the cooperation between the County Planning Department, Fire Departments, and the Colorado State Forest Service have made it possible to implement some level of wildfire protection. There is much more improvement to be made, but without the mutual cooperation between these entities and others, it will be impossible to move forward.

Due to limited resources we are dependent upon the other sectors to also work towards these efforts and, where possible, provide resources. All potential resources should be sought out, including:

- National Fire Protection Association
- United States Fire Administration
- United States Forest Service, Ministry of Forestry in Canadian provinces.
- State forest service's, or department's of natural resources (refer to your states directory of organizations).
- Local fire protection entities, professional and volunteer.
- Universities
- Local fire associations or councils
- Insurance companies

Enforcement

The bottom line to implementing any policy is enforcement. In Jefferson County the enforcement task has been the responsibility of both Jefferson County and the Colorado State Forest Service. The Colorado State Forest Service makes field inspections and when the hazard is adequately mitigated it submits a letter to the Jefferson County Planning Department stating that all necessary actions have been taken. The county then records this with the appropriate sub-division file in the planning and building departments. The county is responsible for verifying that the work has been completed prior to issuing a building permit. Jefferson County will continue to depend on the Colorado State Forest Service to provide services to the county. Our enforcement process is dependent upon their participation.

Local and Private Interests

A common argument planning departments hear from the development community is that planning department processes and regulations cost too much, and that our processes and regulations make housing more expensive than necessary. It is true that local regulations do affect the cost of housing and it is important for local officials to be aware of this fact. It is untrue that regulations make housing unaffordable. The question of cost should be extended beyond the planning and development process into all sectors that implement processes and regulations for protecting lives, property and resources from wildfire hazards.

In the process of designing and implementing regulations it is necessary to determine who is paying, how much, and whether it is reasonable, or necessary. In addition we must also respond to our legislative charter. What are local officials responsible for, and are they acting responsibly towards meeting their legislative and legal mandates? Some questions that must be asked are:

- What is the cost to developers, and ultimately the consumer, for managing wildfire hazards?
- What is the cost to individuals and the general public for not managing wildfire hazards?
- Where do responsibilities lie for implementing wildfire hazard protection programs, and who is ultimately responsible?
- What are the legal implications of managing, or not managing, for wildfire hazards? Is there a legal precedent, and what are the legal liabilities?

Social Attitudes

There are a variety of public attitudes with which planners must contend. They affect how we work with the public and political leaders to effect change. They vary greatly and can be extremely difficult to overcome. The following is a sample of some of the more emotional attitudes that exist in Jefferson County:

- "The more trees the better"
- "More trees means more nature"
- "It won't happen to me", referring to most all hazards
- "Don't cut down that tree!" (There are places in our county that have covenants that restrict a home owner from cutting down living trees.)

A major attitude that must also be contended with is, "How much government is enough?" There is an attitude that government should allow people to live at risk from flooding, fire, and other hazards. It seems there are a number of people who would like to take the risk but would expect society to protect them if a disaster occurred. Government can not be so irresponsible and must implement regulations and standards that provide a reasonable level of safety to all its current and future citizens.

Design and Safety

What is the balance between design and fire protection? Throughout the development process there are conflicting positions regarding architecture, siting, and fire protection. Striking the appropriate balance can be more difficult than it might appear. The following are only a few of the typical conflict areas:

- Cedar shake roof shingles. A beautiful design feature, but left uncared for can result in serious fire hazard conditions. Even when cared for they represent a significant amount of fuel on roofs.
- How much vegetation and how close to leave vegetation next to structures. Frequently mountain / forest area design exhibits a desire to bring nature into the home. All too frequently it is coupled with the attitude that more vegetation is better. The result is homes with heavy fuel loads adjacent to homes, occasionally extending into or under decks, carports and the home itself.
- Road and driveway design. How to design roads and driveways that provide adequate access under emergency conditions, meet local standards, yet are visually aesthetic and environmentally sound.

Managing Small Parcels

The current process manages very small parcels of land at any one time. This is expensive and the overall effectiveness is not as great as if very large parcels were being managed. Without major social change, this situation is unlikely to change. Therefore it is necessary to find as many techniques as possible to increase effective forest management strategies for small parcels.

There needs to be clear understandings of dynamics and techniques that are effective when managing small parcels. For example, with small parcels, it is important to consider the adjacent property conditions, and the uncertainty of management on those parcels. It is probable that to adequately protect a site it is necessary to perform more extensive site modification than normal when there is an adjacent downslope condition that presents a severe hazard and no opportunity to manage it.

Long Term Maintenance

Long term maintenance of hazard areas is a major area of concern. The current process manages wildfire hazards at the time of development. The planning department responsibility typically ends after building permits are issued, with the exception of enforcing zoning violations. This makes it impossible at the current time for the county to implement long term mitigation of wildfire hazards.

To effectively implement long term wildfire protection there are several sectors that must address the problem. Each of these sectors has their own set of opportunities, constraints, and liabilities.

Local governments can assume greater responsibility for implementation and maintenance of wildfire hazard mitigation through a number of services they provide. Planning and zoning departments could implement hazard mitigation during the development process. Health department regulations might be able to enforce long term maintenance requirements. Sheriff departments might take more active fire marshalling and regulatory roles, especially as support organizations to local fire protection entities.

Local fire protection authorities, sometimes part of the local government, need to take greater responsibility not only for the initial mitigation and fire safety education but also for the maintenance of wildfire hazard mitigation. This might be accomplished through implementing new fire codes that address wildfire hazard issues, or extending fire safety regulations to include wildfire hazard concerns.

States might implement a fire marshal program and assign police authority to their state forest service, or other appropriate entities. State forest services can be a resource for information, coordination, and guidance of local governments, fire protection entities, and the insurance industry. This could be especially valuable to rural communities where low tax base prevents the local authority from adequately funding efforts to address wildfire hazards.

Insurance companies could also be more proactive at implementing strategies that encourage long term mitigation of wildfire hazards. This might be accomplished by providing discount incentives, similar to discounts provided for having fire extinguishers and smoke detectors in the home, to those who properly maintain wildfire hazard mitigation. They might require maintenance of wildfire mitigation as a provision for fire insurance.

It is unlikely that any one of these sectors alone has the statutory authority or political support to be particularly effective. It is absolutely necessary for these sectors to work together to determine the most effective way to deliver the service of protecting lives and property from wildfire hazard to their clients, the general public. Central to any effort is providing education between sectors and to the general public.

CONCLUSION

In Jefferson County we have managed to establish a procedure that is being implemented now that addresses the issue of wildfire at the development process. As a part of the development process we require that, where a hazard exists, a forest management plan be implemented prior to the conveyance of property ownership or just prior to building. A building permit will not be issued until a forest management plan is completed.

As a result, we believe that we are doing more to mitigate wildfire hazards in Jefferson County, lowering the risk of wildfire hazard to the homeowner. This also helps the local fire protection districts deliver better service to their constituents. Overall there is better forest management than if it were left totally up to voluntary action by citizens. There is a much better working relationship between the Colorado State Forest Service, fire districts, and the county. Spin off benefits for the Colorado State Forest Service and Jefferson County have been greater public exposure and opportunities to educate the public about wildfire hazards and other concerns.

In the future we hope to improve upon the existing system, formalizing the procedures that are currently done informally between Jefferson County and the Colorado State Forest Service. It is also our intent to solicit a more proactive relationship with fire protection districts. We need to find techniques that can be implemented that will ensure long term maintenance so that hazardous conditions don't recur.

It seems that some kind of hybrid system that uses the best assets of local government, state government, local fire protection entities, and the insurance industry would stand the best chance of succeeding.

The following is a basic framework for an implementation strategy:

1) During the development review process:

- Planning department development review with initial hazard mitigation plan at the time of rezoning or plating. Field inspections by county, State Forest Service and Fire District.
- Colorado State Forest Service provides forest management plan / Hazard mitigation recomendations.

2) Prior to development:

- Inspection by Colorado State Forest Service and release of restrictions when hazard mitigation work is completed.
- County enforces restriction through building permit issuance.

3) After development, owner occupied:

- Fire protection entity with assistance from forest service inspects for wildfire safety.
- Insurance industry requires hazard mitigation as a requirement for insurance, or for discount.

There are many possible variations on this theme. It is offered only as a starting point. In Jefferson County the Planning Department, Colorado State Forest Service and local fire officials have just begun to explore how we can more effectively implement wildfire protection strategies.

GUIDELINES FOR WILDLAND RESIDENTIAL SUBDIVISION DEVELOPMENT

AN ARCHITECT'S PERSPECTIVE

Albert Comly

INTRODUCTION

Subtitle - Eastern Architect in the West

Firm - Curtis, Cox, Kennerly

- 100 people
- Landscape Architecture, Master Planning

Got involved in wildfire initiative in the Spring 1986

OUTLINE OF TALK

Architect

- Job

Influences on Architects work

- Codes/standards
- Design/materials selection

Conclude

- Action items
- What might be done

Architect Job/Task

- Works for client/owner (contract basis)
  - Not always the user
  - Scope of work
- Fulfills service in context of license (health, safety, welfare)
  - Examination - 9 parts over 3½ to 4 days
  - Nonlicensing
- Designs structure to house owners program (needs)
  - Other than houses - 5-foot outside walls
- Prepares documents for contractor to price and build (material selection included)
  - Don't supervise the construction
- Service ends with acceptance of structure by owner/client (maintenance begins)

PRACTICE FACTS

Architects over 80 percent practice in offices with five or less people

- Rugged individualism
- Architects education is general
  - Not experts in fire protection
  - Heavy reliance on codes

CODES/REGULATIONS

Zoning officers job: Everyone wants to be there because open and beautiful. Keep the same way after everyone who wants to be there gets there. Zoning officer must see to this.

DESIGN INFLUENCES

ZONING (legal issues - control by township or county. Mandate for fire department input?)

- Subdivision
- Land development

Governmental Restrictions

- Flood plain management (national maps - local approval)
- Wetlands and water course management (national maps - long approval time)
- Slopes, soil, and erosion control (local approval)
- Special (NJ Pinelands Commission)

Building codes

- Model (southern, UBC, BOCA)
  - Fire safety in structure (compartments, detection, extinguishment)
  - Natural forces (flood, earthquake, ice, snow, wind)

Outline of paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Albert Comly, Architect; American Institute of Architects; Curtis, Cox, Kennerly, Philadelphia, PA.

- Local codes and amendments
- Specific codes (NFPA, NEC, NFPA 101, NFPA 13)
- Maintenance codes (fire prevention, etc.)

Standards

- NFPA (over 700)
- ANSI (handicapped, structural performance, construction)
- NSTM (materials testing)

Environmental concerns

- Hazardous materials (cradle to grave, asbestos)
- Interior air quality (radon)
- Energy conservation

Local requirements

- Design covenants/deed restrictions
- Community architectural review (appearance, historical)

CODES

Approvals that are normally required in East

- Subdivision
- Land development
- Building permit
  - Utility application
- Construction inspection
- Occupancy permit
  - Tax roles
  - Financial packages

AIA policy for building performance regulations. Active participation by architect and public in consensus process.

- Set forth minimum standard for safety, health, and welfare in building construction
- Developed from rationally conceived criteria
- Designed to serve performance rather than prescriptive criteria wherever practicable
- Consistent in development, adoption, interpretation enforcement, and application
- Without favoritism or bias to any special interest
- Cost-effective in relation to public benefit.

ISSUES WORTH STRESSING

Local situation - uniqueness, requiring local solution
Importance of single agency review
- Knowing the hurdles up front

Fire company - importance of written response - to plan review items

- Its possible to have a bad outcome anytime. If only difference between success and failure is arrival of apparatus - that needs correction.

The wildlands problem is not the only problem facing architects; they must also deal with earthquakes, hurricanes, etc.

DESIGN/DETAILS

Conflict between sources (i.e. distance to clear around house)
Lack of available information
Influence of publications

MATERIALS SELECTION/DETAILS

Use of wood

- Self reliance (usually available on site)
- Indigenous (locally available)
- Cultural implications/background (associated with a home in the forest)

Wood shingles/shakes

- Florida - lost 200 houses without shakes or combustible siding.
- Does this mean that shakes are O.K.?
- If all shakes removed - would this conference end? No.
- Red cedar shingle and hand split shake bureau.
- 10-year study of fire retardant at Forest Production Laboratory in Wisconsin - must have retardant reapplied at some interval.
- Other methods - substate fire resistant.
- Decks, porches - need for treatment or use of other material.
- Overhangs, venting, impact on insulation.
- One hour - covering - What is that? Not non-combustible.
- Ratings - residential rec room NBS CFR. Based on time temp curve; 1921 test shows 4 hour wall breached in half an hour.
- It's a complex issue.
- Residence vs. larger buildings?
- Electronic media will allow greater flexibility in where we live.
- Remember - with all this design can be done without architects, according to the laws in some states.

WHAT CAN BE DONE?

Identify goals

- Risk acceptability vs. cost

- Community cost
- Infrastructure (roads, utilities)

Zoning, subdivision, land planning

- Identify and delineate hazard areas
- Consider incentives to allow recouping cost

Codes

- Incorporate in model codes, noncombustible roofs, etc. using performance standards
- Link amount of development with available protection
- Enforce knowledgeably and reasonably
- Recognize that wildfire challenges many existing concepts governing codes
- Consider maintenance, fire prevention code

Follow through

- Publicize subdivisions and development that emphasize wildfire design principles (not just to fire service--use architectural, construction, real estate and development, insurance, homeowner/ popular publications)
- Compile design and maintenance data for all impacted parties (note what is being done about radon)
- Use of design constraints by Federal agencies in wildland/interface areas

Local and state AIA chapters can help. Engineering and landscape professional societies can help also.

THE IMPACT OF LAWS AND REGULATIONS ON BUILDING AND THE BUILDING PROCESS

David J. Dacquisto

ABSTRACT: Potential legal and regulatory approaches to reducing fire hazards in the wildland-urban interface are identified, including conventional methods and significant alternatives. Key issues surrounding the principal strategies are discussed, and likely effects on the building process are identified. Questions to be addressed in judging the need for and the desirability of regulatory intervention are also explored. The analysis suggests that traditional legal and regulatory strategies for dealing with such fires will often be less effective in producing change than the power of information, example and evolving standards of good practice.

INTRODUCTION

A large arsenal of weapons for mitigating the hazards posed by wildfires encroaching on residences in the wildland-urban interface have been identified at a series of conferences focusing attention on fires of this type. Many of the proposed strategies involve training, education, coordination, planning and research, and have only limited legal implications. However the possibility of explicit "legal" or regulatory intervention, in the form of amended building codes, zoning restrictions, or other legislation, is also frequently considered. Evaluation of the set of potential legal strategies is made difficult by the complicated nature of our legal system and our society. This paper describes a range of broadly-defined legal tools that may be available and discusses their impacts on building and on the community at large. It then identifies the types of obstacles and limitations that surround attempts to deal with this part of the fire problem through regulatory action. The goal is to provide a perspective on the range, nature and likely effects of laws or regulations that will guide their effective use alongside conventional firefighting tools.

LAWS, REGULATIONS AND THE WILDLAND-URBAN FIRE PROBLEM

Legal and Regulatory Tools for Fighting Fires

The use of laws and regulations as tools for fighting fires is nothing new. The "health and safety" protected by modern building codes relates predominantly to reducing the risk of fire. The regulatory approaches can generally be classified as "public" and "private" or quasi-public, and according to whether they affect fire safety directly through mandatory requirements or indirectly by altering private incentive structures.

Traditional forms of direct public regulation include building codes and zoning or land use requirements. These affect risk exposure at the dwelling-unit level and at the subdivision or even the community level. Both are mandatory in nature. Changes in zoning and land use practices, together with special prohibitions or requirements in building codes, are probably the most frequently cited examples of legal strategies for mitigating the wildland-urban fire problem.

There are other types of public regulation that have a broad but less direct effect on fire safety. State regulation of the business of insurance is a good example. Insurance premium schedules, discounts, and rating practices are generally subject to state review and approval. Insurance commissions have the power to implement rules producing financial incentives for homeowners designed to discourage particular types of risk exposure. Thus, insurance regulation can affect decision-making indirectly, by affecting market conditions. Insurance companies themselves can also take the initiative where they believe it is actuarially justified.

The classic form of legal action altering incentives involves specifying civil liability in greater detail, presumably giving property owners more responsibility for damage when their actions have contributed to a loss (this might rapidly feed back into insurance premiums). Or, property taxing systems could be used to assess incremental costs of fire protection where they are the

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Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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highest. Factoring in costs that go hidden under current systems helps to prevent consumers from facing artificially low prices for properties in high-risk environments. In this way, various parts of the system can contribute to realization of a market-based solution to the problem, without requiring special definitions of acceptable practice or a long list of official prohibitions.

Fortunately, there are opportunities other than formal action taken by publicly constituted bodies vested with regulatory authority. One type is embodied in consensus standards for design, materials, workmanship and product performance. Of course, some consensus standards find their way into law (model building codes are an example), but the majority are never used in this way. Nevertheless, in the building industry and many others their substance is reflected in evolving standards of "good practice." The power of example here can be more potent than the power of formal regulation. Builders will pay careful attention to meet perceived needs in order to satisfy consumers and remain competitive.

The second illustration of a private system of regulation involves the creation of covenants (enforceable deed restrictions) on real property. This form of "private law" can be used to address the risk posed by wildfires at a neighborhood level without the need for legislation. That is, unsafe land use practices can be prohibited by private agreement early in the development process in lieu of code or ordinance.

Ground Rules on the Availability of Legal and Regulatory Tools

In principle, there are few significant limits on the police power of the state to promote the public welfare by regulation, including building codes and zoning. So long as there is a clear connection between the regulation and the underlying public safety goal, the burden of justification is largely met. There are also few inherent limits on the types of liability laws or insurance incentives that can be established.

The simple basic picture is clouded substantially by several factors. One is the division of power and responsibility across multiple jurisdictions. Federal agencies, state governments, state agencies, local governments, and planning boards all have potential roles. There is no single entity responsible for overseeing or coordinating action; rather, each body works under its own set of powers and institutional restrictions. In many cases, the full range of potential powers are simply not made available to decision-makers. At one extreme, there are large areas where no building codes or zoning ordinances are even in effect, despite their availability in principle.

Once legal or regulatory action has been initiated, the possibility of legal challenge and delay always remains. The constitutional limits on land use regulation are illustrated in First English Evangelical Lutheran Church of Glendale v. Los Angeles County, 107 S.Ct. 2378 (1987), where the U.S. Supreme Court made it clear that a development moratorium ordinance denying all reasonable use of a property interest, even temporarily, could be grounds for awarding compensation to an owner. The moratorium in that case related to flood hazards, but the principle is relevant to other settings, including severe restrictions based on potential risk of fire. On the whole, First Church and other cases serve primarily as a reminder that there are limits on land use regulation. They place little or no restraint on the vast majority of conventional land use regulation, on building codes, or on the use of other legal and regulatory tools previously identified. In practice, the limits are set more by knowledge, public opinion, and the ability to achieve a consensus.

IMPACTS ON BUILDING AND THE BUILDING PROCESS

The range of potential impacts of legal and regulatory measures dealing with the wildland-urban fire problem is broad. Specific effects will depend on details of the particular measure in question. This discussion will identify general types of effects and the situations in which they can be expected to result, based on principles of economics and historical experience in various regulatory settings.

Ordinarily, impacts on building and the building process will be the result of impacts on consumers, developers, builders, manufacturers, and other parties. These points of view need to be distinguished in discussing the subject. Ultimately, of course, it is the impact on consumers that is of primary interest. The time horizon is also important: some impacts can be expected in the short-term, while others will naturally take longer to materialize.

There are two reasons for expecting the impacts on builders themselves of much likely regulation in this area to be small. First, builders are accustomed to functioning in an increasingly complex regulatory environment. Adherence to new building code requirements, zoning restrictions or other provisions of law are an inescapable part of doing business. Builders also generally operate in highly competitive markets, so increased production costs due to regulation are rapidly passed through to consumers of housing in the form of higher prices. They will tend to price out marginal buyers and shift others towards resales, but that is not the same as builders absorbing cost increases out of pocket. Over the long run, impacts will instead fall on consumers, owners of undeveloped land, and the growing community itself.

From the consumer's standpoint, many regulatory measures would lead to direct cost impacts. These would include extra costs for building materials and labor, as well as extra financing costs and property tax liability. Insurance reform would obviously affect the cost of property insurance. Zoning and subdivision-level regulations that reduce density and increase infrastructure costs per housing unit for roads or utility services, or

dedicated open spaces and prescribed land and vegetation management practices would generate corresponding cost impacts. Of course, costs are not the only impact. The regulations would also affect the physical environment surrounding the buildings. This is their very purpose.

Increases in the cost of housing due to regulation have traditionally concerned the building industry as well as others interested in the availability of decent, affordable housing on a broad scale. Rising costs increase down payments and monthly payments, making qualification for mortgage loans more difficult. Such increases can drive less affluent consumers entirely out of the market for entry-level housing. Yet, it appears that considerations of affordability could be less important with respect to regulation here than in other current settings. This is partly because of the limited scope and local nature of the problem: most housing simply should not be affected by well-designed regulations. Also, many (but not all) of the homes at risk are luxury homes, second homes, or vacation homes where affordability is not the most important consideration.

Costs such as those identified above constitute the initial round of economic impact. They will trigger a further set of economic adjustments, or second-order impacts, that can take many different forms. Examples include locational shifts in building activity (depending on the scope of the regulation), and changes in land values as the profitability of development changes. Their magnitude generally becomes smaller as they become more remote from the particular law or regulation involved.

The economic impacts of regulation are neither good nor bad in and of themselves. Any such judgment requires evaluating their effect on risk exposure and the resulting implied benefits. In principle, where they are "cost effective" they can be good policy, while where they are not cost effective, they are economically inefficient and objectionable.

A further class of impacts might be called "inadvertent." In attempting to solve one problem, it is often possible to make another one worse. For example, it could be disastrous if homes that were sited to reduce the risk of fire suffered from increased risk of flash flood, avalanche, or other natural hazards. It is easy to lose sight of the fact that the wildland-urban fire problem is symptomatic of the need for an integrated approach to hazard management in certain special types of residential occupancies.

The remaining impacts to be discussed are no less important than the others. Building takes place in an environment that is larger than the specific words of laws and regulations. This environment can be shaped informally, by example from other communities or jurisdictions, and by consensus standards that do not have the force of law. In many ways, these forces, and not the technicalities of statutory language, serve to drive events. Good practice can involve adherence in substance to requirements that are not necessarily legally enforceable, and the impact of a law, a regulation or a standard often depends on its power to catalyze change outside its original domain. This is only enhanced by the power of modern mass communication. Where the problem and the solution are clearly understandable, positive change can be achieved with a minimum of formal intervention.

DEVELOPMENT OF A REGULATORY AGENDA

Moving forward towards regulatory solutions to address the wildland-urban fire problem is no simple task. For while the power of the state to regulate is very broad, its willingness to do so is often much more narrow. Proposed regulatory action will be subject to close scrutiny by many parties, some of whom will not understand or appreciate the issues involved. Multiple bodies will sometimes be involved in setting policy, each with its own constituency and institutional objectives, some of which have little to do with public safety as such. Thus, achieving regulatory change can prove very difficult in practice. The procedural requirements often include explicit factfinding and public hearing on the effects of specific proposals. And implicit in the final decision is the political task of setting of overall priorities: deciding which problems merit action now, and which can be deferred until later.

The most significant obstacle to regulatory change here may be the perception, valid or invalid, that residential fires in the wildland-urban interface are not now a major problem, either in absolute terms or by comparison with other types of fire. The perception rests on the finding that for the United States in 1985, wildfires caused 44 fatalities and destroyed or damaged 1400 homes. This is around 1% of all residential fire fatalities. More lives can easily be lost in one large hotel fire; according to the National Weather Service more people are killed by lightning in an average year. The benchmarks will vary from one setting to another, but the recurring question will be whether public or private funds spent on reducing this risk might be better spent on more general fire prevention, or for other purposes. On the other hand, the disproportionate property losses associated with these fires (hundreds of millions of dollars each year) must also be considered. Additional factors such as growth in losses or risk of major disaster are potentially relevant to setting policy, but are usually less compelling than demonstrated loss experience. A solution requires identifying narrow classes of high risk in advance.

An important possible goal to keep in mind when pursuing reform is the creation of an environment in which normal market forces can work to eliminate a problem, rather than trying to address it by affirmative regulatory requirements. That is, work to ensure that insurance incentives are not distorted, that taxing policies reflect costs of service, and that risks are known and understood. Then rely on the natural operation of the market to bring about a situation in which risks reflect the preferences of the consumers

whose tastes led them to this special environment in the first place.

In formulating an agenda for regulatory change, the use of less overt methods for achieving the desired ends should not be overlooked. This includes fostering the development of consensus standards and model approaches that address this problem along with others. The building industry participates in and has considerable respect for this process. As previously mentioned, this approach can be effective in altering general practice, even where it is not official law. It is also groundwork that can be repaid many times over in facilitating reform at the local level. Finally, it is easier because there are relatively few bodies developing consensus standards compared to the fifty states and thousands of local governments that ultimately enact the official rules.

Among the other factors to consider in fashioning regulation is the question of focusing on new housing as opposed to global risks, or all housing. By their nature, most building codes and standards affect new construction almost exclusively, while the current fire risk clearly lies entirely with existing structures. The long lives of buildings and slow turnover of the housing stock mean that at best a strategy targeted strictly at new building could take decades to produce detectable benefits, without affecting risks within the current stock. Assuming that fires in the wildland-urban interface are a serious problem today, calling for near-term action, then solutions dealing with risk to all affected structures, new and existing, offer a faster way to achieve tangible benefits than those focusing on new buildings alone. This points to the importance of regulating activities and practices such as outdoor burning and vegetation management that contribute to the problem but have nothing to do with housing.

Whatever the future of legal or regulatory change in this area, it is possible that the most important opportunity afforded by this problem involves drawing attention to the risk of fire, through vivid media coverage of wildfires presenting catastrophic hazards to residential properties. This offers chances to provide large audiences with information on how to prevent or deal not just with outdoor fires, but also with the more common types of residential fires.

SUMMARY AND CONCLUSIONS

Several types of legal and regulatory strategies are available for mitigating the risk of wildfires to residences in the wildland-urban interface. In addition to traditional tools like building code requirements and zoning ordinances, there are several less formal methods for achieving regulatory effects, including insurance reform, private covenants and consensus standards. Legal and regulatory steps, where effective, are bound to have impacts on consumer prices similar to those resulting from other types of economic regulation. Whether the net impacts are beneficial or detrimental depends entirely on the regulation and the surrounding circumstances. A regulatory strategy need not involve dictating technical solutions. It is sometimes simpler to focus on eliminating distortions in underlying economic forces, allowing the market to seek its own solution.

Formal action in this particular area has been slow to emerge. The simplest alternative here requires working in a voluntary, consensus context to define the problem and specify practical remedies systematically before broader audiences. Organizations, procedures and tools for this type of change are already in place.

SESSION 6

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THE WILDLAND RESIDENTIAL FIRE PROBLEM: A FIRE ENGINEER'S PERSPECTIVE

Brooke B. Smith, Jr., P.E.

ABSTRACT: The role of the fire protection engineer as a member of the development team designing residential property in wildland areas is presented. Integrated design using the fire protection engineer to review aspects of prevention design and to develop recommendations for protection design is shown to be effective. The design of water supply to the wildland residential development is especially important and the fire protection engineer's contribution in this area is explained in detail.

INTRODUCTION

Understanding the wildland residential fire problem and helping in the development of solutions to the problem are somewhat new and yet very challenging areas for the fire protection engineer. The engineer's established scope of practice however, of how to safeguard life and property from the hazards of fire is certainly adaptable to this problem (Society of Fire Protection Engineers 1985). By simply changing the traditional scope slightly to read:

> ...safeguarding residential life and property from the hazards of wildland fire...

certainly brings into focus the subject situation, and sets the challenge for today's fire protection engineer specializing in the residential wildland fire problem.

As with any profession, the practice of fire protection engineering may be directed in many areas including design, enforcement, research, teaching and training. All of these areas of practice have application to the residential wildland fire problem, but design is the area selected for additional discussion.

Design for wildland fire safety should be done as part of the overall property development process if it is to be effective and economical, and all members of the development team should incorporate emergency fire conditions as an integral part of their development activities. Failure to design in adequate provisions for the prevention, control and extinguishment of wildland fires tends to invite their frequent occurrence with the consequent losses of life and property. In addition, wildland fires have deleterious effects upon the environment causing damage to the very surroundings that have attracted residents to the development in the first place. Add-on fire safety, planned after a development has been designed or constructed, is inherently more expensive and generally less effective than that engineered as an integral part of the total residential development (fig. 1).

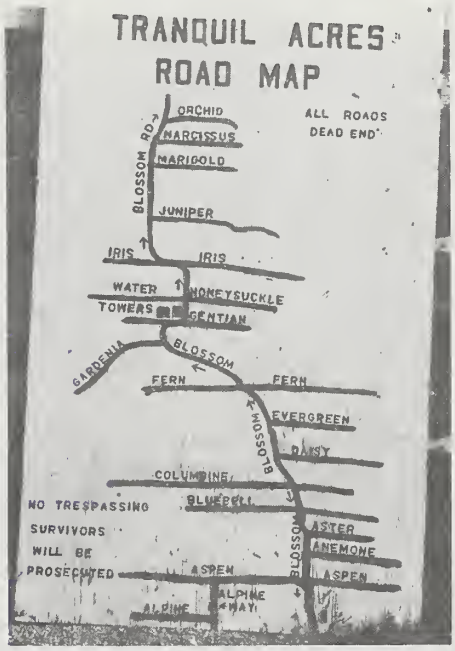

Figure 1--Road map of wildland residential development indicating that all roads are dead end. It would be most difficult to improve access now since all of the roads are constructed and lots platted.

THE DEVELOPMENT TEAM

Residential development in wildland areas throughout the interior west is in many areas, already a very complicated process. The developer is required by law in many cases, to surround himself with surveyors, planners, architects, engineers, lawyers, and financiers. This large and expensive group of consultants is needed to deal with current subdivision regulations, zoning rules, building codes and fire codes so that the developer can simply get to the point where he can start to sell property and construct homes. The mere thought of adding a fire protection engineer to help deal with the wildland fire problem would probably be frightful to the developer if he were not already somewhat numb from the whole process.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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What is hoped for however, is that by adding the fire protection engineer to the development team, the developer is not simply introducing just another cost center. Hopefully, he will be giving the overall program of subdivsion fire safety, which already has to be considered, coordination and direction. The fire protection engineer's role with the project team would involve the development of overall subdivison fire safety measures which would necessarily include those related to the wildland fire problem.

Implementation of these fire safety measures can reduce the exposure of life, property and resources to an 'acceptable level of risk' and provide 'defensible space' that could protect residents and enable firefighting equipment and personnel to operate during a wildfire (California Department of Forestry 1980).

THE FIRE PROTECTION ENGINEER'S ROLE

The wildland fire problem is generally known not to have a single solution due to the hazards, risks and complicating factors. A combination of remedies is usually required to achieve any reasonable degree of fire safety for structures in or near wildland areas (Moore 1981). The fire protection engineer's involvement with the development team should be viewed as helping the developer with formulating these remedies.

In general, project involvement by the fire protection engineer would typically include work described by activity in the following areas:

Prevention Design

This involves efforts to 'design out' of the development as many hazardous conditions as is prudently possible in order to reduce the chance that a loss will occur. Prevention design by the fire protection engineer is ususally accomplished through particpation with the development team in the following areas:

Establishment of Fire Hazards--The natural fire hazards of a wildland area are relative and generally vary with the fuel loading, ground slope and weather. These hazards are frequently quantified by local forest officials into a classification system that defines severity zones. In states such as Colorado and California, these severity zones have been mapped. The fire protection engineer should use this data to map the specific hazard severity zones for the development. If hazard classification systems or mapping do not formally exist, the fire protection engineer should seek help from local forest officials to establish severity zones and prepare maps for the property under development (fig. 2).

The Fire Hazard Map for the development becomes a very important document to be shared by the entire development team during the planning process.

Reduction of Fire Risk--The basic fire prevention problem in any environment is the separation of flammables and combustibles from sources of ignition. This is especially true in the wildland situation where most of the fire risk is man-made.

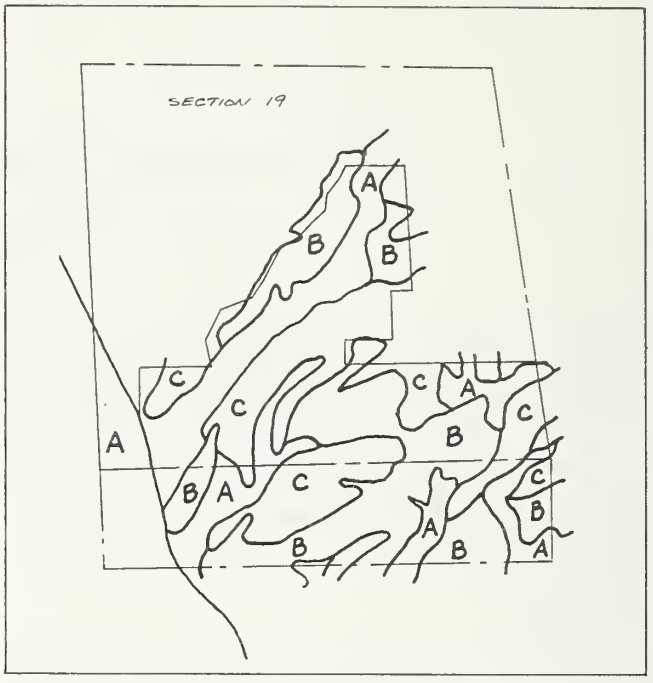

Figure 2--Wildland Fire Hazard Map of proposed development based on data from the Colorado State Forest Service. Scale: 1 inch = 2000 feet. Hazard Classes: A--Low Hazard; B--Medium Hazard; and, C--Severe Hazard.

The fire protection engineer should provide recommendations to the development team addressing underground electric lines, protection of flammable liquid and gas storage tanks and residential clearance to native vegetation (fig. 3).

Review of Development Design--The design of the development encompasses many aspects and is generally a team effort of planners, engineers and surveyors. Most communities also have adopted subdivision regulations that set certain 'minimum' requirements for lot density, building spacing, access roads, parks and greenbelts. In many cases, these 'minimums' are followed by the development team without regard to the wildland fire problem.

Figure 3--Obvious example of inadequate clearance from residential building to native vegetation.

The fire protection engineer, using the Fire Hazard Map as discussed above, needs to provide input during the early phases of development design so that 'minimum' requirements are modified if needed to compensate for the wildland fire hazard.

If the community in which the residential development is being constructed has not adopted subdivision requirements that meet the basic needs for development in wildland areas, the fire protection engineer should recommend that such generally available standards be reviewed, modified if necessary, and then adopted by the developer for the project. References for such standards include publications by the U.S. Forest Service, California Department of Forestry and the Colorado State Forest Service.[1]

Review of Building Construction--The building construction phase of a residential development may or may not be undertaken by the property developer, by whom the fire protection engineer is usually employed. However, since the design and construction of buildings is such an important part of the residential wildland fire problem, it is important for the fire protection engineer to participate in this phase of the development if at all possible. One way to help control the construction of buildings, even if the developer is not the builder, is through the use of deed restrictions or covenants prepared by the developer as part of the planning process for his subdivision.

Of prime importance are materials acceptable to the fire protection engineer for building roof coverings. Also of importance are considerations of glass areas, exterior siding, overhangs, decks and stilt construction (fig. 4). The fire protection engineer should recommend to the development team that design and materials for building construction in a wildland area be consistent with generally available standards. References for such standards include publications by the U.S. Forest Service, California Department of Forestry, and the Colorado State Forest Service.[1]

Protection Design

This involves efforts to 'design into' the development fire safety systems to limit damage and loss, should an incident occur. Usually, this design is not essential to the operation of the development, but it is essential to the preservation of life,

Figure 4--Multifamily dwelling in wildland area with wood shingle roof and siding.

property and resources under fire conditions. Protection design is almost always under the direction of the fire protection engineer, and the preparation of detailed drawings is usually done in cooperation with the remainder of the development team. Included are considerations of:

Water Supply--Water, which is available in sufficient quantity and for the time required, is still the most effective fire safety measure for combating both wildland and structural fires. Therefore, a large, dependable source of water above that required for normal daily domestic purposes should be provided at the time the development is planned (Alger 1971, National Fire Protection Association 1985). The design of this water supply has to be considered one of the most important contributions the fire protection engineer makes to the development. The supply can take on several forms depending on the domestic water arrangements.

If the subdivision is to be supplied by a connection to a municipal water system, then the design usually only involves extensions to the distribution system and location of valves and hydrants (fig. 5). Depending on location however, the design may include provisions of booster pumps, storage tanks or pressure reducing stations. If the subdivision is to be supplied by a private system that is only capable of domestic flows or if individual homes are supplied by wells, then the design may involve the placement of water storage cisterns and the development of suction connections to ponds or streams (fig. 6).

Water supply is considered so important to the development and the fire protection engineer's responsibility so significant that this topic will be covered in greater detail hereinafter.

Fire Station Placement--In large developments or those somewhat remote from existing fire stations, local laws may require dedication of a site within the development for a new fire station. The fire protection engineer should work with the fire suppression officials who will be responsible for the development in selecting an appropriate site. If such local laws do not exist, but the

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[1]Moore, Howard E. 1981. Protecting residences from wildfires: a guide for homeowners, lawmakers, and planners. Gen. Tech. Rep. PSW-50. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 44 p.

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Figure 5--Addition of fire hydrant by extension of existing municipal distribution system.

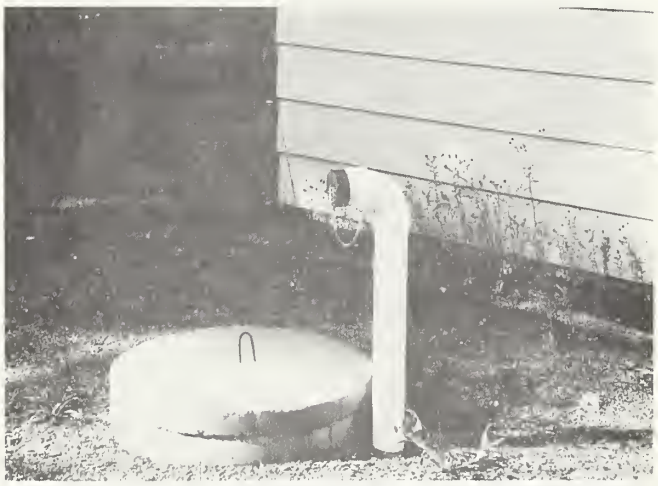

Figure 6--Underground water storage cistern with fire department pumper connection.

development is over 640 acres in size or over 4 miles from the nearest fire station, the fire protection engineer may still want to recommend to the development team that a fire station site be dedicated (Moore 1981).

Emergency Access--As discussed previously in the section on Development Design, access is one of the important aspects of development in wildland areas. Of course, access designed in accordance with proper standards is desired, but occasionally (usually due to topography) only one form of regular access is possible. In these cases, the fire protection engineer would be responsible for the possible development of emergency access routes for use during a wildfire or other emergency. These may involve steep connections to lengthy cul-de-sacs, or tie roads through adjacent property not available for normal traffic (fig. 7).

Figure 7--Emergency access to residential subdivision using 'push to break, weak link chain' as barricade.

Fuel Breaks--The locations of both perimeter and local fuel breaks in the development require consultation between the fire protection engineer, local forest officials and the rest of the development team. Frequently, golf courses, greenbelts, parks and open space that are either required by law or simply planned as an amenity by the developer, can be arranged to function as fuel breaks. These spaces, especially perimeter fuel breaks adjacent to forest areas, require dedicated easements for fire vehicle access. Local fuel breaks around individual residences should be required in deed restrictions or covenants should the developer sell land for building by others.

Interior Dwelling Protection--The Uniform Building Code is in use throughout the interior west and it has a number of requirements for interior fire protection of all dwellings. These include the current provisions of smoke detectors and the proposed provision for mandatory automatic sprinkler systems. The requirement for automatic sprinklers in residential properties is getting more attention especially with the development of quick response sprinklers and the ability to use plastic materials for sprinkler piping (National Fire Protection Association 1984).

If automatic sprinkler systems are required or anticipated in the development, the fire protection engineer should take this into consideration when designing water supplies. Some local fire jurisdictions have taken the position that provision of mandatory automatic sprinklers in residences will reduce the demand of fire service personnel required due to reduced water supply requirements. While the provision of sprinkler systems will reduce the water supplies needed for interior protection, the fire protection engineer should carefully consider if such reductions can be made to the system without impacting the needed fire flows for wildland fire control.

THE DESIGN DOCUMENTS

When dealing with the wildland fire problem, it is of utmost importance for the fire protection engineer to establish the bases or philosophy for

the above prevention and protection design recommendations. This philosophy should consider the wildland hazards and risks in concert with the developer's preferred master plan and all applicable local laws and codes. The engineer must realize that not only are his services of immediate cost to the developer, but usually his recommendations will, in one way or another, reduce the future amount of money to be realized from the development. For this reason, the fire protection engineer should make his recommendations in writing during the preliminary work on the development's master plan so that the development team will have time to consider the impact of the fire safety measures proposed.

This written report or design document should describe the proposed development, the wildland hazards and risks, and the proposed prevention and protection recommendations. This preliminary document should be circulated to the developer and all members of the development team first, so that all 'in house' comments can be addressed. Hopefully, a consensus report from the development team can then be finalized. This document is then sent to local forestry officials and all development legal authorities (city, county, etc.) for review and comment. It may take several revisions for the design document to be accepted by all parties, but once accepted, implementation of the proposed designs can take place.

The acceptance of this design document is a most significant step for the fire protection engineer. Many of the items of prevention and protection design are covered sufficiently in this document so that implementation by others on the development team is rather straightforward. For example, the development planner can simply incorporate on his plat the desired location of greenbelts and fuel breaks; the development attorney can prepare subdivision covenants relative to acceptable residential building materials; and, the development surveyor can lay out the desired locations of emergency access roads.

The design of the water supply system for the development however, may require significantly more involvement by the fire protection engineer. Although his responsibility in this effort is usually directed at basic design and definition of scope of work to the development civil engineers, the fire protection engineer should carefully review all civil construction drawings in order to be certain that the requirements of his basic water supply design are being met. This would include review of the fire hydrant and valve placements, distribution pipe size and placement, storage tank size and placement, and any required pump specifications. Following completion of construction, local fire authorities may want selected fire flow tests of the completed system performed to verify conformance to the fire protection engineer's basic water supply designs.

WATER SUPPLIES

The design of water supplies to meet a fire emergency in a development is normally based on the requirements for fighting an interior residential fire. In most cases, this design criteria is adequate for protecting the building from an encroaching wildland fire as well. This is because the interior requirements reflect both the financial property risk and multiple life risk (Moore 1981).

Of course, part of the problem with wildland areas is that sufficient water may not be available for either interior or exterior protection. Many homes are supplied from individual wells or 'domestic only' central systems. This situation is viewed as being on the decrease however in most new residential developments in the interior west due to increased fire awareness and local laws. Many communities have adopted the Uniform Fire Code which requires adequate water supplies to meet building structural fire demands.

Needed Fire Flows

After carefully reviewing the development for density, building spacing and building materials, the fire protection engineer should establish the needed fire flow for the 'typical' residential building proposed for the subdivision. Guidelines for calculating needed fire flows are published by several sources, with that from the Insurance Services Office (ISO) used most frequently.

A typical one or two family dwelling not exceeding two stories in height with at least 11 feet between buildings would result in an ISO Needed Fire Flow of 1000 gallons per minute (gpm) at a minimum residual pressure of 20 psi (Insurance Services Office 1980).

The water supply system is also required by ISO to have the Needed Fire Flow available for a minimum of two hours. In this case that calculation would yield a volume of 120,000 gallons of water that should be reserved for fire protection use above that required for normal daily domestic purposes (fig. 8).

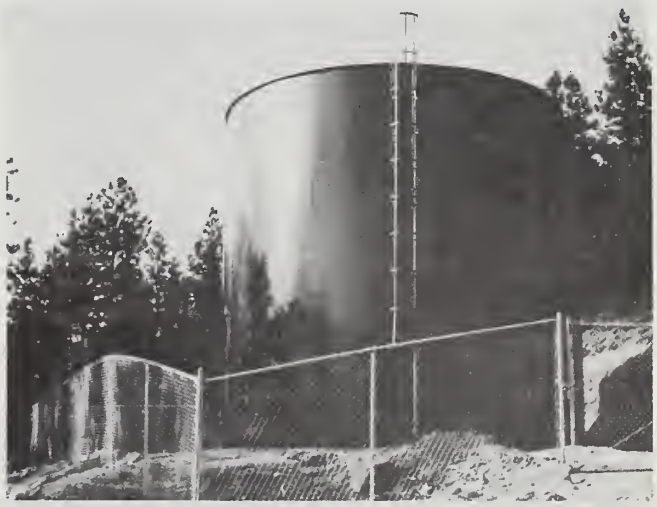

Figure 8--Water storage tank sized to provide sufficient capacity to meet the required 2 hour water demand for fire protection. This volume is required in addition to that necessary for domestic purposes.

As stated above, Needed Fire Flows calculated for interior building protection are also generally acceptable to meet the danger to the development from wildland fires. This assumption should be carefully evaluated by the fire protection engineer along with local forest and fire suppression personnel. It is possible that extreme wildland conditions or subdivision configurations may require fire flows larger than that required by ISO for a residential interior fire.

Available Fire Flows

After determining the above requirements for needed fire flows, the fire protection engineer should then determine available supplies. If the proposed development is to be served by an extension to an existing water supply, a fire flow test should be performed close to the proposed extension location (fig 9). The data derived from the flow test will establish the Available Fire Flow of the existing system at that location, which is the gallons per minute of water that can be provided at a minimum 20 psi residual pressure.

The proposed water distribution system is then analyzed to determine the Available Fire Flows present throughout the development. This analysis frequently utilizes computer programs to assist with the calculations necessary for multiple loop water systems. Unless the Available Fire Flow exceeds the Needed Fire Flow at all locations, adjustments to line sizes are sometimes required to reduce friction losses. In some cases, a specific need may be identified for either booster pumps or pressure reduction stations.

Figure 9--Fire flow test in progress. Tester is taking pitot pressure readings at the flow hydrant to determine the quantity of water (gpm) discharging from each hydrant outlet.

Distribution System

The distribution system should be arranged with multiple loops of piping, eliminating as many long dead ends as possible. This is almost always to everyone's advantage (including the developer) because friction loss is lowered and frequently the pipe line can be reduced in diameter (minimum 6 inch). Not only does this reduction save the developer installation cost, but the looped system is also more hydraulically efficient and dependable. In developments with cul-de-sacs, a good design technique is to extend the possible dead end water main along lot lines (in dedicated easements) to complete a loop arrangement (fig. 10).

Figure 10--Portion of a water distribution map for a residential development in a wildland area. Note the loop formed by extending the water main down the property lines between points A and B.

Fire hydrant placement is also covered by ISO guidelines and in general, the fire protection engineer will find these suitable for development in wildland areas. Fire hydrant spacings of 300 to 500 feet as measured along the road frontage are common and acceptable for most developments. All hydrants should be provided with large diameter fire department pumper connections as well as smaller hose connections.

The distribution system should also incorporate an adequate number of line valves to isolate sections of the system for repairs. The fire protection engineer should provide enough valves so that no more than one or two legs of a loop are out of service at a time. The maximum line length between valves should be limited to 1200 feet.

CONCLUSIONS

As the problem of residential development in wildland areas continues to be addressed, it appears that the contributions from fire protection engineers can be of significance especially as a member of the development team. Although this position establishes the developer as the client, it also puts the engineer in a position to substantially contribute to the design of the project at a time his skills can best be utilized. In addition to loyalty to the developer as his client, the fire protection engineer, through society ethics, is also dedicated to the safety, health and welfare of the public (Society of Fire Protection Engineers 1985).

With this dedication to public safety, the fire protection engineer is viewed as functioning as somewhat of a legitimizer for the developer, and as such is considered a critical member of the development team. In this role, the fire protection engineer can help bridge all sides of the Wildland/Urban Fire Triangle (fig. 11). This participation should help lead to solutions of the residential wildland fire problem.

Figure 11--The wildland/urban fire triangle (National Wildland/Urban Fire Conference 1987).

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FIRE-SAFE BUILDING PRODUCTS: RESEARCH FINDINGS

Susan L. LeVan

ABSTRACT: The Forest Products Laboratory (FPL) has served as the national center for wood products research since 1910. The Fire Safety of Wood Products research work unit of FPL is generating new technologies to improve the fire safety of wood-using construction. Our fire research program concentrates on fire growth, fire endurance, and fire retardants. This paper discusses the research activities in each of these areas.

INTRODUCTION

Designing a fire-safe building in urban areas depends on the intended occupants of the building and the location. Building codes limit the potential for fire damage by considering the occupants and the location (Spelter and others 1987). Fire performance requirements for materials for a hospital or nursing home differ from those materials required for a commercial shopping center. In the wildland/urban interface areas, homes and buildings should be constructed using this same philosophy of matching probable risk caused by the location with the level of acceptable hazard for the occupants. If the risk is high, then the level of acceptable hazard for the occupants may dictate noncombustible building materials, aluminum fire shutters, and other precautionary measures. However, if the risk is low to moderate, then homeowners have more options in selecting the building materials, including wood.

Although wood is combustible, the esthetic and rustic values of wood are what many homeowners in the interface area want. However, the hazard of fire in these areas indicates that compromises must be made between what is safe and what is desired. Today we have many design procedures which can be used to reduce the hazard to wood building materials during fire. Certain chemicals can be applied to wood to reduce its flammability. Such research information is applicable to structures in the wildland/urban interface area to improve the fire performance of wood construction materials. This paper addresses the ongoing research at the FPL to improve fire performance of these wood products.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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BACKGROUND

The Forest Products Laboratory, Madison, WI, has served as the national center for wood products research since 1910. Over the years, the FPL has continued to improve its research capabilities to remain a leader in wood research. The underlying mission of the FPL is to improve utilization of wood through research that leads to improved management and use of the timber resource, thus meeting the needs of the United States and contributing to the international community. Inherent in this fundamental philosophy is the criterion that FPL research properly address both the current and future needs of its user groups.

At the FPL, my research work unit's mission is to generate technology for improving fire safety of wood-using constructions. Because of the large use of wood products in commercial and residential applications, architects and engineers must be concerned with the performance of wood materials in a fire and, in particular, how these materials will affect the life safety of occupants and firefighters. To understand the fire performance of wood materials, we need to know how wood products contribute to the growth of a fire and about their ability to maintain structural integrity during a fire. Once these performance properties are known, the potential risk of using these materials can be addressed.

FIRE RESEARCH

Our fire research program concentrates on three areas: (1) fire growth, (2) fire endurance, and (3) fire retardants. Fire growth is concerned with the initiation of the fire, its spread and propagation. Fire endurance pertains to the ability of the structural assembly to maintain structural capacity. Fire retardants are chemicals added to wood products to alter their flammability. This paper describes some of the current and planned work in each area.

Fire Growth

Computer fire growth models describe the fluid dynamics which occurs in a room with a fire and the interaction between the fire and the various materials. These models use the input properties described below to generate a probable sequence of events and to describe the growing temperature development within a room from initiation, propagation, and finally flashover. However, these models are in their infancy, and considerable more research is necessary to improve their accuracy.

At FPL we are evaluating the capabilities of many of these fire growth models that were developed at the National Bureau of Standards, Center for Fire Research (Bukowski 1986; Jones 1984; Mitler 1985) and at Ohio State University (Sauer and Smith 1983). We use these models to assess the potential risk involved with particular designs or materials. Fire growth models also can be used to improve the fire safe design of a building such as the location of windows, doors, and smoke detectors. Currently, we are building a room to conduct full-scale room burn tests. These room burn tests are used to verify the fire growth models.

To describe how wood contributes to the fire growth process, we measure the heat release rate, the smoke generation rate, and the flame travel rate, all as a function of the external properties such as moisture content, density, and the imposed heat flux. We measure these properties on small-scale equipment and on full-scale assemblies. Ongoing work at FPL aims at defining these properties so that we can adequately describe the pyrolysis and combustion process of wood. We determine the rates of heat release, mass loss, and production of gases for selected wood species using an Ohio State Heat Release Rate Chamber. Empirical equations are being developed for heat release rate as functions of heat flux, density, moisture content, and time. Also, recent data quantify smoke production rates under non-flaming conditions. We obtained empirical equations that describe the smoke generation properties of particulate concentration and optical density of red oak and Douglas-fir plywood as functions of heat flux and time (Tran, in press).

Our research program in fire growth modeling is aimed at four objectives:

1. Assessing the various fire growth models that have been developed.
2. Developing subroutines specific to wood products.
3. Developing a data base of fundamental properties which can be input into fire growth models. These fundamental properties include thermal conductivity, specific heat, heat of combustion of the volatiles, etc.
4. Verifying fire growth models for wood products with full-scale room burn tests.

Using these fire growth models, we will gain valuable information concerning which parameters are the most important and how we can improve the fire performance of wood.

Fire Endurance

Work has been underway at the FPL to define the fire performance of conventional light-frame construction. Wall and floor performance has received special attention in the past (Schaffer and others 1983). Currently, efforts are concentrated on trusses and other fabricated wood products on the market. The basis for design of assemblies is to contain a fire within the room of origin. To do so the wall or floor assembly must act as a barrier to the fire. Typical assemblies are exposed to a standard fire test, ASTM E 119 (American Society for Testing and Materials 1985a), and the time is observed at which certain criteria are reached. The criteria include structural failure and the temperature rise on the unexposed surface.

Several years ago, the only way available to gain code acceptance of an assembly was to conduct a fire test by certified agencies. However, code authorities have increasingly accepted engineering analyses of fire performance. We, in the fire research unit, concentrated our efforts on developing models and design procedures for determining the fire endurance ratings of wood members and assemblies (Schaffer 1984).

In future research, we envision the fire growth models to define the exposure to an assembly, the heat transfer models to describe the flow of heat through the membrane and into the assembly, and the structural response models to calculate times to structural failure. All three make up a fire endurance model. The fire growth models have been previously discussed. The discussion will dwell now on structural response and heat transfer modeling.

The structural response of a wood member or assembly during a fire depends on the performance of its protective membranes, if any, the charring of the structural wood element, and the structural capacity of the remaining uncharred portions of the structural wood elements. FPL research has demonstrated that the fire endurance of a wood member can be calculated if it is assumed that (1) the strength properties in the entire uncharred region are a fraction of their room temperature value due to the temperature gradient within the member, (2) the charring rate is constant, and (3) the member fails when it is no longer capable of supporting its load which is some fraction of the ultimate load. Using these assumptions and the corresponding structural analysis models for the various members and assemblies, fire endurance formulas have been developed for unprotected joist floors (White and others 1984; Woeste and Schaffer 1981), glued-laminated beams (Bender and others 1985; Schaffer and others 1986), and unprotected floor trusses (Schaffer and Woeste 1981). Presently, we are developing such analytical procedures for walls and protected parallel cord and roof trusses. As part of our efforts on fire endurance of trusses, we have obtained new equipment that allows us to load a wood member in tension and simultaneously subject it to high temperatures or a direct fire exposure.

To calculate the residual mass of a wood member, we need to know the rate at which the wood undergoes thermal degradation. Currently our charring rates are based on fire exposures defined by a standard time-temperature curve (ASTM E 119 test method) (Schaffer 1967; White and Schaffer 1981). A theoretical charring model has been developed by Parker (1985) at the National Bureau of Standards. The model calculates the rate at which heat is released from the wood and the depth of the char layer using fundamental properties as input.

We need to know the rate at which heat is transmitted through a protective membrane such as gypsum wallboard. We are working cooperatively with Forintek Corp., Canada, on a heat transfer model for structural assemblies. We also worked with the University of California to develop a heat transfer model for light-frame wall assemblies. The finite element model can be used to simulate the ASTM E 119 fire test of a wall assembly (Gammon 1987). This allows us to determine the fire exposure of the assembly.

Also for certain applications, such as rehabilitation of a building, there is a need to improve the fire endurance of wood members. The steel industry improves the fire endurance of steel members with specially formulated fire-resistive coatings. These coatings are not designed for wood. However, we conducted evaluations of the steel coatings applied to wood and found that they could improve the fire endurance time of wood members. We developed empirical equations to determine the coating thickness needed to obtain a certain fire endurance rating (White 1984, 1986). Discussions are being held with chemical coating manufacturers and the wood industry to evaluate the commercial potential of such coatings for wood.

Fire Retardants

Fire retardant treatments (FRT) are frequently used to reduce the flammability of wood products. FRT can be pressure impregnated into the wood or they can be applied as a coating. Chemical impregnation has the greater use, primarily for new materials. Commercial testing agencies evaluate the effectiveness of the fire retardant systems using the 25-foot tunnel test, ASTM E 84-84a (American Society for Testing and Materials 1985b). Both coating and impregnation systems are based on the same chemical components, although the formulations for each vary. Most of the chemicals used in flame retardant formulations for interior finishing are based on empirical investigations for best overall performance. These chemicals include the phosphates, some nitrogen compounds, borates, and amino-resin systems. These compounds reduce the flamespread rating but can have adverse effects on other wood properties. The level of reduction on flamespread ratings depends on the total loading level of the chemical (LeVan 1984).

Most of the fire retardant treated lumber uses interior type chemicals that may leach out when exposed to outside weathering conditions. The need for exterior treatments resulted in a concentrated effort by many researchers in both government and industry, including the FPL. The research concentrated on exterior treatments for wood shakes and shingles. Today exterior fire retardant treatments exist for western redcedar shakes and shingles which qualify them for a Class C shingle or a Class B (ASTM E 108-83) (American Society for Testing and Materials 1985c) roof system. These treatments have been evaluated for durability under outdoor weathering conditions for 10 years (LeVan and Holmes 1986). Of all the treatments evaluated, the commercial treatment performed best in fire tests after 10 years of outdoor weathering. Some of the other formulations, which we made at FPL, performed well in the Class C burning-brand test but showed increased flamespread in the modified Schlyter test. Coating systems did not demonstrate long-term durability. Coating systems do not prevent the natural weathering of wood and are lost as a result of defiberization of the surface wood cells by ultraviolet light.

Research, in progress, is concentrating on developing combined preservative and fire retardant treatments for several western whitewood species. To achieve this we are evaluating the fire performance of several preservative treatments and are conducting compatibility tests of various fire retardants and preservatives. We are examining single-step treatment processes and two-step treatment processes. The information gained from this study would be applicable to other species. Such dual systems will greatly enhance the commercial applications of exterior wood products.

In other fire retardant research at the FPL, we are examining the mechanism of strength degradation due to FRT and high temperatures (Winandy and others 1987), the efficacy of FRT for structural corrugated material and other composite products, and the fundamental fire properties of fire retardant treated wood.

APPLICATIONS TO THE WILDLAND/URBAN PROBLEM

Based on previous conferences, such as this, on the wildland/urban initiative, one research element that has routinely been expressed is the need for fire risk analysis models. These models take into consideration the past historical probabilities of fire, the current topography, the forest fire hazard models, the building fire hazard models, the available suppression techniques, etc. The data base generated at FPL will provide information for these fire risk analysis models to help describe the response of the building under various wildfire scenarios. New design procedures could be developed to mitigate the fire hazard and allow cost optimization. These design procedures could be incorporated into design manuals specifically for wildland/urban interface areas. They would present alternative construction systems and materials and provide greater flexibility to architects and builders.

However, caution must be exercised in using fire risk analyses models. The models are intricate, complex simulations and are only as good as the data on which they are built. Therefore, it is necessary that reliable and consistent information be used, which accurately describes the probable scenario. Cooperative effort will be needed among all agencies to ensure that the data base is appropriate. Discussions should start addressing what information and format are needed. Such discussions will facilitate the utilization of these fire risk analyses models in the future by ensuring a sound and reliable data base.

CONCLUSIONS

This paper encapsulates the research work on fire being carried out at the Forest Products Laboratory. These areas include fire growth modeling of fires in compartments, fire endurance analytical procedures to describe the capabilities of structures during fire, and the effectiveness of fire retardant treatments to alter the flammability of wood products. This research will provide a source of information to help describe the response of wood building products to a wildland fire scenario and can be used in fire risk analyses models. Also, the FPL can help develop new design practices that can mitigate the fire hazard in these areas.

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A PRIMER ON FIRE ECOLOGY, FIRE BEHAVIOR, AND FUEL MANAGEMENT FOR THE WILDLAND RESIDENT

Ronald H. Wakimoto, Panel Moderator

As I look back over the years and reflect on the wildfire problem along the urban fringe, I think about my first organized encounter with the topic. In 1971, as a graduate student at Berkeley, I attended a meeting of the Governor's Task Force on California's Wildland Fire Problem. For the most part, the topics discussed at that meeting were the same as we have discussed here--building clearance enforcement, inadequate access, interagency coordination needs, improved construction codes, lack of zoning restrictions, etc. The big difference I see between then and now is our openness about not being able to protect every home and our emphasis on the need for homeowners to accept the responsibility for fire safety.

This panel program was designed as a homeowner's primer to fire ecology, fuels and fire behavior, and fuel management. It is our belief that to motivate a homeowner into action, he or she must realize that fire has always been a common occurrence in the vegetation of the Interior West--the vicinity of today's wildland homes--and that this must be considered in home design, placement, and landscape design.

As plants grow, they shed leaves, twigs, and branches. Over time shrubs and trees die out and are added to these other fuels. The limited rainfall in the Interior West allows fuels to build up since the rate of fuel accumulation is greater than the rate of decomposition. In the past, lightning-caused fires and those ignited by native peoples, reduced this fuel buildup over large areas. In addition, these fires favored plant species adapted to recurrent fires. The extermination of native cultures and effective fire suppression have allowed fuels to build up for over 100 years!

Once a homeowner accepts the fact that a damaging wildfire is likely to occur, he or she must also have a feeling for the expected fire behavior so that home design, home placement, and landscaping design can be cost-effective, and socially acceptable. When I say fire behavior, I mean the rate of fire spread, the length of the flames, and the likelihood of fire spreading into the crowns of trees or by burning embers flying long distances through the air in front of the fire.

An understanding of the potential fire behavior should help answer many homeowner questions. What fire behavior can be expected in the different vegetation types in the Interior West? Should homesite planning favor long flames with greater radiated heat or lesser flames with a rapid rate of spread? What roof coverings are acceptable? How wide a clearing is necessary to help protect a home? Will window shutters help? How about sprinklers on the roof? Should one fight or flee when the fire comes?

Finally, the homeowner must understand the importance of fuel management. Homes with properly managed fuels may be selectively defended by limited fire suppression forces while other homes will be allowed to burn. How much fuel is too much? Should these trees by cut or limbed up? How long will the fuel management effort last? Unfortunately, in many cases, the threatening fuel hazards lie outside the homeowners property boundary. Only informed homeowners, working with government agencies, can bring about a socially acceptable political solution to manage these hazards.

I hope that the panel presentation will increase homeowner understanding of the growing fire problem and their role in its solution in the Interior West.

Panel discussion presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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FIRE ECOLOGY OF VEGETATION COMMON TO WILDLAND HOMESITES

Stephen F. Arno and Ronald H. Wakimoto

ABSTRACT: A synopsis of fire history and implications for fire management is presented for six major vegetation types of the interior West that contain large numbers of homes. For thousands of years prior to 1900, these vegetation types burned periodically. During the current century, however, fire has been suppressed and fuels have been accumulating, increasing the hazard of uncontrollable fire. Homeowners can greatly reduce the threat of severe fire damage by thinning and otherwise managing their wildland surroundings.

Suburban homeowners are well aware that cultivated vegetation such as lawns, gardens, and shade trees grows continually. They recognize that this vegetation requires trimming or cropping to prevent it from becoming rank and unacceptable. One reason that suburbanites move to wildland settings may be to escape the drudgery of such cultivation.

We have some good news and some bad news for the hundreds of thousands of new homeowners in wildland settings of the inland West. The good news is that they can indeed reduce the time spent cultivating vegetation. The bad news, however, is that wildland vegetation also accumulates and requires cropping to prevent it from fueling a home-destroying wildfire.

Wildland vegetation can be thought of as a natural fuel that has, since time immemorial, been cropped and regenerated by fires. When protected from fire, grazing, and wood harvesting, vegetation can develop into a dangerous fuel that sustains severe, uncontrollable fires. However, this vegetation can be cropped in such a manner that it becomes more aesthetically attractive while greatly reducing the risk of severe fire damage.

Modern Americans are accustomed to living in a cultivated landscape of cities, suburbs, and farms, where fire is generally considered an intruder. In recent years, multitudes have emigrated from that familiar setting and have built new homes in the wildlands, where fire is an important part of the natural scheme. In the interior West, the major vegetation types harboring wildland homes include semi-arid grasslands, sagebrush, dwarf-conifer woodlands, and various kinds of coniferous forests. Each of these types evolved under a characteristic pattern of fire frequency and fire severity known as a "fire regime." With limited exceptions, fire was an important natural disturbance in all these vegetation types.

Fire has had a major influence on vegetation in the shrublands, dwarf-conifer woodlands, and lower-elevation forests where large numbers of wildland residents have recently settled. A large body of evidence concerning fire history in the interior West has been gathered through the study of fire scars on ancient trees and stumps, charcoal sediments in ponds, and accounts of early travelers. Comparisons of hundreds of historical and modern photographs (retakes) of the Western landscape show a dramatic increase in density of shrubland, woodland, and lower-elevation forests. Also, this shrub and tree growth has expanded into former grasslands. Our knowledge of the responses of different plants to fire confirms the authenticity of this trend.

The evidence shows that prior to the late 1800's, frequent fires swept through the grasslands and dry-site woodlands of the interior West. The time period between fires at a given point on the ground ranged from only a year or two in the ponderosa pine forests of northern Arizona (Dieterich 1980) to a few decades in some of the mountain grasslands (Arno and Gruell 1983). Moist lowland forests in northern Idaho experienced fire on the average of once in a century (Arno and Davis 1980). Lower and middle elevations of the inland West were dominated by species that were best adapted to survival and regeneration in a fire environment (Habeck and Mutch 1973; Wright and Bailey 1982).

Patterns of frequent fires can be traced back thousands of years through charcoal layers in ponds (Mehringer 1985). Several factors were responsible. Abundant ignitions were caused by lightning and by Native Americans. The region's semi-arid climate provides dry periods favorable for burning, and prior to settlement by European-Americans, the landscape was a nearly continuous bed of fuels. Fires in forest and woodland types would often burn for a few months, covering vast areas, until finally extinguished by heavy rains or wet snows in autumn. Historic

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observations of fire are provided, for instance, by explorers Lewis and Clark, who encountered 10 wildfires in their travels through what is now Montana and Idaho in 1805 and 1806 (Gruell 1985).

Beginning in the mid-1800's, major changes affected fire frequency: (1) heavy livestock grazing and cultivation broke up the formerly continuous lowland fuels; (2) the nomadic lifestyle of Native Americans was abandoned, reducing ignitions; and (3) by the early 1900's organized fire suppression had become well established throughout the West. As a result of these changes, the amount of fire in grassland and dry forest types decreased dramatically. For instance, fire history studies show that most ponderosa pine stands that experienced fires at 5-10 year intervals prior to 1900, have recorded only 0-2 fires since 1900 (Martin 1982; Stokes and Dieterich 1980).

With this general scarcity of fire, shrubs and trees have expanded into former grasslands and have thickened in formerly open woodlands. Grazing has been reduced or eliminated in many wildland residential areas, resulting in buildups of dry grass and other fine fuels that allow fires to spread rapidly. The general trend is a thickening of vegetation that contains large amounts of dead, highly-combustible material. This trend varies by vegetation type; consequently we will describe specific conditions associated with some of the major types that harbor wildland residential development in the interior West.

PRAIRIE GRASSLANDS

Prairie grasslands cover vast areas of the western Great Plains and smaller areas west of the Rocky Mountains. Collectively these grasslands represent millions of acres of continuous fine fuels. Since time immemorial, grasslands experienced frequent fires started by lightning and Native peoples (Eiseley 1954). The combination of a semi-arid climate and abundant fine fuels makes the occurrence of fire almost inevitable. Early travelers and residents of the prairies often battled fires, with great losses of livestock, forage, fences, homes, and entire towns (Jackson 1965). Dry grass fuels were available during much of the year, and a single fire might spread to massive size before being checked by rainfall, a previously burned site, or a broad river.

Although major portions of the prairie grassland have been converted to cropland and crisscrossed by roads, the annual buildup of fine fuels continues on much of the landscape. This creates a potential for enormous fast-moving wildfires. Many homes in this setting are isolated buildings with cured grass extending right up to the exterior walls. Concentrations of modern "ranchettes" encircle many prairie towns and magnify the problem of protecting structures and people from wildfires.

The good news is that most grassland fires are relatively easy to suppress because the quantities of fuel per acre are low and fuels burn out quickly. Direct flame contact is usually required to ignite structures, and fire spread by airborne embers from the flaming front is limited. Hence, hand clearing of grass fuels from around buildings or establishment of watered lawns can provide protection from wildfires in most grassland situations. Livestock grazing can greatly reduce the amount of fine fuel, lessening the severity of burning and slowing the rate of fire spread. Additionally, road systems can be used as fire breaks.

The bad news is that fuel clearance around homes must be done every year. Despite the modest quantities of fuel, grass fires driven by strong winds can be dangerous and fast-spreading. As the density of home development increases, fuel reduction by grazing tends to be reduced or excluded. The vastness of the prairie lengthens response times for firefighters. Much of the land is protected by volunteer firemen who must drive from long distances to man the fire trucks. In many cases the rapid growth of a grassland fire taxes the limited suppression forces and prevents protection of numerous scattered homes.

Central Montana's Hawk Creek Fire of 1984, spread primarily through grass fuels and then burned at high severity in accompanying groves of ponderosa pine. This fire's rapid growth illustrates the difficulty of containing a grassland fire. In 3 days it covered 24,000 acres. Then, strong winds pushed the inferno nearly 10 miles in 2 hours along a flaming front 3 miles wide! The fire front was so broad that suppression was impossible until weather conditions moderated.

SAGEBRUSH-GRASS

The sagebrush-grass vegetation type covers about 100 million acres of the interior West, mostly in the valleys and lower mountain slopes. These shrublands have become popular building sites for "country living." Perhaps because this land is less expensive than woodland, development tends to be dispersed over large areas; this makes it difficult to defend homes from a wildfire.

Studies of fire history and vegetation change indicate that prior to settlement much of the current sagebrush-grass type was a fire-maintained grassland that burned at intervals of perhaps 20 to 30 years (Arno and Gruell 1983; Houston 1973). Many of the drier or rockier sites were historically sagebrush and burned at longer intervals--30 to 70 years (Gruell 1986; Harniss and Murray 1973; Wright and others 1979). Most species and varieties of sagebrush are killed by fire. Thus, these shrubs were less abundant in the past when fires were more frequent. Livestock grazing on these lands since the 1800's has led to sagebrush dominance over large areas with native perennial grasses virtually eliminated. Introduced weedy species such as cheatgrass often provide abundant fine fuels.

The good news is that sagebrush is a non-sprouting or weakly-sprouting shrub that can be easily thinned out or removed around home sites. Such clearing may be effective for 10 years or longer. Grazing limits accumulation of fine fuels in many areas, which hampers fire spread.

The bad news is that each year some severe, wind-driven fires develop in sagebrush-grass types. These spread rapidly and are uncontrollable until the weather moderates. Sagebrush-grass fires generate much higher intensities than grassland fires, leading to ignition of homes by radiation and spotting (fire spread by wind transport of burning embers) as well as by direct flame contact. The openness of sagebrush-grass landscapes allows strong winds and wind shifts to play havoc with fire suppression tactics.

In 1987 conflagrations raced across sagebrush-covered slopes on the outskirts of both Boise and Pocatello, ID, forcing hasty evacuations of dozens of homes. Luckily, winds moderated in time to prevent large losses. Only three homes were destroyed. During the same summer, the Acorn Fire on the east slope of the Sierra Nevada destroyed 24 homes and damaged six others. Burning under the influence of the "Washoe Zephyr," a strong hot-dry wind (foehn), this fire spread at over 6 miles per hour in sagebrush-bitterbrush-grass fuels. Spot fires repeatedly developed 1/4 mile ahead of the fire front. Fortunately, the Acorn Fire eventually spread up against an area that had previously burned in another severe fire, and the lack of fuels aided the control effort. Use of prescribed fire by professionals at strategic locations may be necessary to limit fire spread and avert home damage in the sagebrush-grass type.

DWARF CONIFER WOODLANDS

Dwarf conifer woodlands made up of various species of juniper, pinyon, or occasionally limber pine cover vast areas of the interior West. These expanses of dense, bushy conifers are popular for residential development because of the screening and privacy they afford in otherwise open, semi-arid country. Residential development in dwarf woodlands is common in central Oregon and along the eastern base of the Cascades and Sierra Nevada--for instance, near Reno. It also is abundant at Santa Fe and around many of the other higher-elevation cities and towns in the southwestern United States.

Evidence from historical photographs, original land-survey records, and vegetation studies indicates that the dwarf conifer woodlands have become more dense and have often expanded into former sagebrush-grass types during this century (Burkhardt and Tisdale 1976; Gruell 1986; Martin and others 1978; Rogers 1982; Wright and others 1979; Young and Evans 1981). This can generally be attributed to livestock grazing that removed grass fuels and thus prevented surface fires from spreading. Prior to the late 1800's, periodic fires helped maintain open or patchy stands in many areas that now support dense woodlands.

The good news for modern residents is that surface fires in these woodlands are often hampered by sparse fuels. The bad news is that under hot, dry, windy conditions, severe crown fires can develop. These create an inferno that defies control despite modern fire-suppression technology. This type of fire racing through continuous fuels will consume homes lying in its path. For example, in 1981 a fire in sagebrush and conifer woodland nearly overran the town of Austin, NV, including a National Forest ranger district headquarters. The fire started 2-1/2 miles from Austin, but, despite suppression efforts, covered 6,000 acres in 6 hours. The town was saved largely because of a last-minute shift in wind direction.

PONDEROSA PINE

Ponderosa pine forests (including the closely-related Jeffrey pine) are abundant in the Western United States. As a result of their accessibility, relatively mild climate, and aesthetic appeal, hundreds of thousands of homes now occupy these forests from the Black Hills of South Dakota to the mountains above Los Angeles, and from the sunny lake country of south-central British Columbia to the suburbs of Flagstaff, AZ, and Boulder, CO.

Because of its large, shielded buds and thickening layer of protective bark, ponderosa pine begins to develop resistance to surface fire at an early age; consequently it is well adapted to survival under a regime of frequent fires. Oldgrowth trees throughout the species' range often have charred wounds or "catfaces" that show scars inflicted by 10 to 30 individual fires. By dating these multiple fire scars, researchers have learned that prior to 1900 most stands burned at intervals ranging from 2 to 25 years (Martin 1982). Frequent surface fires thinned out the smaller trees and kept the stands open and park-like. This allowed little opportunity for fuel buildup and stand-destroying crown fires.

Since 1900, however, most of these forests have experienced few if any fires. Modern stands tend to have dense patches of understory trees and a buildup of pine-needle litter and woody fuels. When a wildfire occurs under warm, dry, windy conditions, it often develops into an uncontrollable crown fire that destroys the forest and any homes within it.

By contrast, in a few cases severe wildfires have spread into ponderosa pine stands where prescribed burning or other fuel reduction had been carried out (Biswell 1977; Biswell and others 1973; Cooper 1960; Wagle and Eakle 1979). In each case, when the wildfire reached the previously treated stand, it stopped burning through the tree crowns and became a controllable surface fire.

The ponderosa pine zone has a semi-arid climate, and after a few days of dry weather, pine-needle litter burns readily. Therefore, spreading fire is possible during much of the year. As far as homeowners are concerned, the good news is that fuels management is very effective and can be carried out in a variety of ways. The bad news is that without fuels management the risk of severe fire damage is great and fires can threaten homes even during the seasons when fires are generally uncommon.

In August 1984 the Hawk Creek Fire burned 44 homes in a ponderosa pine forest north of Billings, MT. These were mostly newer homes in untreated pine stands with fuels adjoining the buildings. In an evaluation of the fire, suppression officials concluded that these structures could have been saved if fuels management had been initiated. In 1985, 19 homes were destroyed in north-central Washington by the Barker Mountain Fire as it spread across ponderosa pine-covered slopes. Protection efforts were hampered by the dispersion of homes in secluded locations and by poor access roads.

In 1987, the Hangman Fire burned two dozen homes in a pine woodland subdivision near Spokane. Land Commissioner Brian Boyle stated that there are probably thousands of developments in Washington similar to Hangman Hills that face similar risks (Spokane Spokesman-Review, 19 July 1987). Moreover, the district fire chief declared that people with secluded homes in the forest outside the subdivisions are at substantially greater risk.

The number of homes in hazardous fuel situations in the ponderosa pine type throughout the West has increased rapidly in recent years, and unless fuels management is begun in earnest it seems inevitable that large losses of forests, homes, and possibly lives will occur.

MIXED FIR

Mixed fir forests occupy moist zones in the high mountains throughout the interior West. They also occur at lower elevations in northern Idaho, northeastern Washington, northwestern Montana, and southeastern British Columbia. These forests are a diverse assemblage containing Douglas-fir, grand fir, or white fir in mixture with other conifers. Small towns, outlying residences, summer homes, and ski and summer resorts are abundant in these forests as far south as the White Mountains of Arizona and New Mexico.

These forests burned infrequently in the past, at average intervals ranging from 20 to 150 years (Arno 1980; Dieterich 1983; Martin 1982). Fir forests containing sizeable quantities of ponderosa pine represent the shortest of these intervals. Prior to 1900, mixed fir forests experienced a range of burning from light surface fires to stand-destroying conflagrations. In mountainous topography an individual fire often left a patchy mosaic of contrasting burn treatments. This in turn broke up the continuity of fuels available for subsequent fires.

Residential developments in these forests today are generally surrounded by dense vegetation, both in the tree layer and undergrowth, which becomes a fire hazard only during an infrequent, severe summer drought. Because of the infrequency of such a hazard, home and resort owners in mixed fir forests are likely to be less conscious of fire and preventive measures than their counterparts in drier vegetation types. When fire does occur in these fir forests under extreme burning conditions, the luxuriant vegetation suddenly becomes a copious fuel.

Several small settlements in mixed fir forests were burned in the Great Idaho Fire of 1910; the mining city of Wallace barely escaped being razed (Cohen and Miller 1978). Severe fires are still uncontrollable, as witnessed by the Sundance Fire of 1967 that raced toward Bonner's Ferry, ID, burning more than 50,000 acres in a 9-hour run (Anderson 1968). In 1977 the Pattee Canyon Fire in a mixed fir forest near Missoula, MT, blew up and rapidly destroyed 1,200 acres including five homes. Ironically, if the same fire had occurred a decade later, many more homes would have been consumed, since subdivision development was just beginning in 1977. In 1979 and again in 1984, fires threatened the suburbs of Bonner's Ferry, despite the town's location on a large river.

In recent years the quantity and value of developments placed within untreated fir forests has increased dramatically. The frequency of conflagration in these types is comparable to that of a severe flood in a floodplain setting and the property damage potential from the fire equals or exceeds that of the flood; however the damage from fire is preventable with fuels management.

LODGEPOLE PINE

Lodgepole pine forests occur on relatively cold dry sites in the mountains of the interior West. Major resort and summer home developments occur at many locations including Banff and Jasper in Alberta, the Yellowstone-Grand Teton region, and the Colorado Rockies. In most of these developed areas, lodgepole pine is a fire-dependent species that burned in stand-replacing fires, primarily caused by lightning, at intervals of 50 to 150 years (Arno 1980; Hawkes 1980; Tande 1979). In some of the lodgepole pine forests, moderate surface fires also occurred and probably influenced the frequency of severe fires.

Populations of the mountain pine beetle (a native bark beetle) periodically build up and kill most mature lodgepole pines (>80 years old) over vast acreages. These epidemics create massive quantities of fuels, which are very slow to decay and remain available to support a conflagration.

In most areas, the very existence of a lodgepole pine forest testifies to a history of repeated,

often severe fires. Lodgepole pine is considered the premiere fire-adapted species of the mountain forests, a sort of "Phoenix tree." Without periodic fires it is usually out-competed and replaced by other less fire-adapted trees such as subalpine fir and spruce. Lodgepole, however, bears abundant crops of wind-borne seeds at an early age. Large numbers of its seeds are also stored in protective closed cones that survive fire. These cones open only as a result of fire's heat and their seed falls into the excellent ash seedbed. The new stand grows up densely stocked and may later be killed by beetles--increasing the probability of severe burning, which will again favor the establishment of lodgepole pine. When lodgepole pine stands become old they become quite flammable as a result of tree mortality and a buildup of understory trees.

Large uncontrollable wildfires occur somewhere in the lodgepole pine forests during most years. In 1984 a wind-driven fire threatened summer homes and resorts on the east boundary of Glacier National Park. In 1985 another lodgepole pine forest fire, this one in central Idaho, blew up unexpectedly and overran 73 Forest Service firefighters (Rothermel and Mutch 1986). Their lives were saved only because they carefully assembled in clearings and crawled inside special metallic fire-tents. Luckily this fire occurred in an undeveloped area. Similar heavy fuel loadings can be found in lodgepole pine forests near many mountain resorts and summer home areas.

For property owners in lodgepole pine forests the good news is that fuels management is relatively easy and quite effective. The bad news is that because of the infrequency of fire hazard and the short season of occupancy on most of these sites, it is tempting to postpone fuels management. Unlike firefighters, resorts and summer homes cannot be slipped into a metallic fire shelter at the last minute to survive a fast-moving wall of flames. Even if this could be done, the all-important green forest setting would still be obliterated and property values would plummet. With intensive management to thin the trees and reduce the surface fuels even the surrounding forest can be protected from wildfire.

In conclusion, it is essential that wildland homeowners recognize that they live in one of nature's "fire environments." The risk of wildfire is substantial and comes with their property. But homeowners can vastly reduce the potential damage from wildfire to their lives, homes, and wildland homesites. In contrast to the suburban homeowner who cultivates vegetation primarily to make it aesthetically pleasing, the wildland resident has an additional compelling reason to manage his vegetation--survival. Fortunately, the cropping of wildland vegetation can also enhance aesthetics and it can yield firewood or other useful products. The presentations that follow tell homeowners specifically how to reduce the wildfire threat in different wildland vegetation types.

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FUEL CHARACTERISTICS AND FIRE BEHAVIOR CONSIDERATIONS IN THE WILDLANDS

Hal E. Anderson and James K. Brown

ABSTRACT: Characteristics of forest fuels, how they are related to flammability, and the types of fires most hazardous to wildland homeowners are explained. Tables and figures are presented to increase those homeowners' awareness of wildfire potential and hazard. Dangers of firebrands are emphasized. Means for reducing available fuels and flammability levels are discussed.

INTRODUCTION

Wildland fires pose problems for suburban and rural homeowners as they try to protect their investments. In much of the western United States, the potential for fire problems develops in the spring, heightens in the summer, and can continue into the late fall. Firefighting agencies begin strengthening their resources in the spring and sustain them into the fall. Wildland dwellers need to develop the same readiness and be aware of how fuels and fire potential can endanger their lives and homes. In this paper we explain fundamental aspects of wildland fuels and fire behavior.

FUEL CHARACTERISTICS

Moisture content may be the most important single property controlling flammability of both live and dead fuels. It reflects weather and climate and can change rapidly. Moisture content is usually expressed as a percent of oven dry fuel weight. Live and dead fuels retain water in different ways and respond differently to changes in weather. The moisture content of dead fuels fluctuates with changes in relative humidity and fuel temperature. Rainfall, of course, also affects fuel moisture content. Thin particles, such as dead leaves and grass stems that are loosely arranged, can change moisture content considerably in only a few hours. In contrast, days and weeks of drying conditions are required for moisture content of dead limbwood and down logs to change significantly.

Moisture content of living vegetation changes primarily in response to seasonal growth stages. For example, moisture content of herbaceous plants typically ranges from 200 to 400 percent oven-dry weight (OD) early in the growing season. Depending on species, it gradually decreases to 100 to 200 percent OD by late summer. Then as plants, such as annuals, or parts of plants die, moisture content drops dramatically and responds thereafter as dead fuel moisture content. This process can be hastened by summer drought. Shrubs undergo a similar change, but as long as the stems and leaves are alive, moisture content usually remains at or above 80 to 100 percent OD. The significance of seasonal change in moisture content is that (1) some live vegetation becomes dead fuel, which has considerably lower moisture content; and (2) the moisture content of the remaining live vegetation is lowered, thus, less energy is required for ignition.

Fuel quantity influences whether or not a fire will spread and determines how hot it will burn. It is expressed as tons per acre or in similar units. For a surface fire to spread, there should be at least 1/2 ton per acre (Wright and others 1979) of dry, fine fuel dispersed over the area. Fire intensity is directly proportional to the quantity of fuel that burns. All vegetation is not necessarily fuel. The quantity of vegetation that is available to burn is called "available fuel" and depends on several other fuel properties, particularly the proportion of vegetation that is dead, fuel particle size, moisture content, and continuity. Fuel quantity varies greatly across the landscape even within short distances. Clumps of fuel formed by patches of shrubs or young conifer trees intermixed with fallen tree boles, branches, and twigs often account for flare-ups and surges in fire intensity that cause crowning and spotting.

Flammability increases markedly as the quantity of finely divided dead fuel such as leaves, stems, and twigs increases. The size of fuel particles is important because it relates to rate of heating and moisture exchange. Thin fuel particles have large surface areas compared to volume. Thin particles will generally dry out and ignite quickly because the large proportion of surface area to volume permits rapid exchange of moisture and heat; larger fuel particles take longer to ignite. Since fire spread is really a series of ignitions, thin fuels support higher rates of spread than large fuels because they ignite faster.

Compactness refers to the spacing of fuel particles. It is often expressed as weight of fuel per unit volume of fuel bed. The best way to reduce flammability by altering compactness is to compact fine fuels and separate or spread large fuels. Combustion is maximum when fine fuels are loosely compacted. Thus the fuel particles are close enough to receive intense heat radiation

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from adjoining burning particles but not so close as to restrict flow of oxygen to the burning fuel. The forest floor of ponderosa pine is more flammable than in fir and lodgepole pine forests because the long needles of ponderosa pine produce a fluffy, less compacted litter layer than the short needles of fir and lodgepole pine.

Continuity of fuel refers to the distribution of fuels both horizontally and vertically. Continuity partly controls where a fire can go and how fast it travels. Horizontal continuity can be thought of as a uniform or patchy distribution of fuel. Spread of surface fire and crown fire is interrupted in patchy fuels and can be more easily suppressed. When the crown canopy of conifers is less than 75 percent closed, crown fire potential is reduced substantially (Fahnestock 1970).

Ladder fuels, such as moss hanging in trees, needles draped on shrubs, and shrubs and small conifers growing beneath larger conifers increase flammability and likelihood of crown fire by creating vertically continuous fuels.

The properties of fuel vary considerably within and between vegetation types. Perhaps the most important difference is the length of time during the year that fuels and fire behavior potential remain hazardous, which largely reflects moisture content. Dry landscapes that support vegetation such as sagebrush, pinyon pine, juniper, and ponderosa pine have low dead-fuel-moisture contents much longer during the year than higher elevation conifer forests of fir and lodgepole pine. Usually, quantities of downed woody material are greater in the fir and lodgepole pine forests than in drier forests and dwarf woodlands. Also, tree crown canopies are more continuous in fir and lodgepole pine forests. Thus, when surface fuels are dry, high intensity crown fires are more apt to occur in these forests.

Fuels are Ever Changing

Fuel conditions change greatly across the landscape and they change with time on the same piece of ground. Some fuel characteristics, such as moisture content, can change rapidly while other characteristics change slowly over a period of years. The variations in fuel can cause pronounced changes in fire behavior. Homeowners, land development planners, and forest managers all need to recognize that fuels and fire behavior are dynamic phenomena. They are not fixed in time or place.

The moisture content of fine dead fuels can change in a few minutes due to rainfall. In the absence of precipitation, moisture content of dead fuels fluctuates with constantly changing temperature and relative humidity. Seasonal growth and curing of herbaceous vegetation result in production of lush live vegetation that dries into flammable fine fuel in only a few months.

Most fuel characteristics such as quantity, size, continuity, and the proportion of dead-to-live material change slowly over time. Quantities of available fuel, both dead and live, and continuity may increase or decrease over time as a result of two interacting processes (fig. 1) (Brown and See 1981). Fuels accumulate due to growth and mortality of vegetation, which creates available dead fuel. Countering accumulation is the depletion of fuels primarily due to decay, fire, or human physical removal. Growth of trees, which for some species increases the distance to their live crowns, can reduce available fuel by creating breaks in vertical continuity.

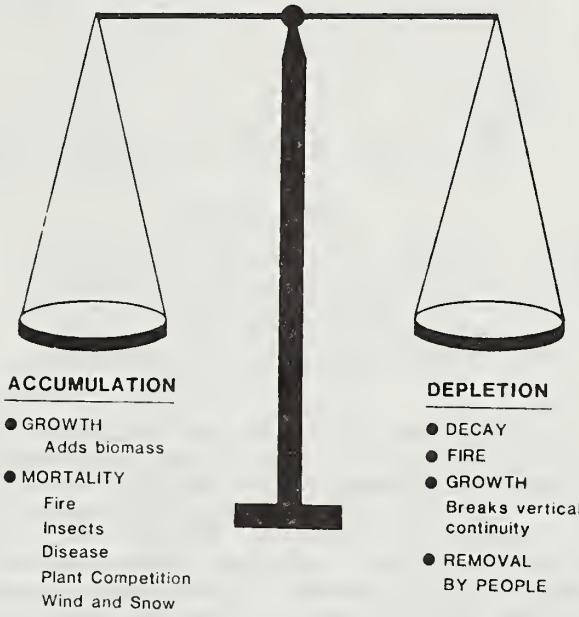

Figure 1--Fuels increase and decrease over time as a result of interacting processes.

Following a disturbance such as a severe fire or land clearing, the recovery of vegetation follows a similar pattern on many sites. First, herbaceous plants appear and dominate the site for a few years. Then shrubs appear and increase in quantity. Finally, trees dominate the site, and the quantity of shrubs and herbaceous vegetation is reduced by competition. This process may occur over a time period ranging from 50 to 100 or more years depending on the site and initial vegetation. Accumulation of live and dead fuels, as well as small and large fuels, can follow different patterns. Mortality to vegetation due to insects, disease, fire, wind and snow breakage, and plant competition occurs irregularly. Thus, creation of dead surface fuels is less predictable than the growth of live vegetation.

Consider how fuels change in different vegetation types. In sagebrush-grasslands, perennial grasses typically increase rapidly following fire and remain with high coverage for about 60 years. Sagebrush increases slowly, peaks in coverage after about 30 to 40 years, then decreases. Junipers increase markedly after about 40 years and dominate the site after 60 or more years (Frischknecht 1975). The likelihood of high intensity fire is greatest when sagebrush and perennial grasses are available to carry fire into the crowns of juniper. As trees get bigger and surface fuels are reduced, initiation of high intensity crown fires is more difficult (fig. 2).

Figure 2--Hypothetical probabilities of high intensity wildfire due to changes in fuel over time since last stand replacement fire for lodgepole pine (LP) and ponderosa pine (PP) forests and pinyon-pine-juniper (PJ) woodlands.

In ponderosa pine forests, without repeated fires, surface fuels increase steadily over time largely due to the thickening of a conifer understory (Gruell and others 1982; van Wagtendonk 1985). The understory often serves as ladder fuels, which can readily ignite a crown fire. Ponderosa pine forests are most flammable after a conifer understory has developed and is maintaining good continuity with dead surface fuels. Today, many ponderosa pine forests in the western United States have developed high intensity fire potentials. Shrub and conifer understories have thickened due to absence of fire which historically thinned these stands.

The accumulation of fuels in fir and lodgepole pine forests is more complex because surface fuel flammability depends on fallen dead woody material. Generally, in overmature forests, potential fire intensity is high because of accumulated fuels (Brown and See 1981). In young to mature forests, fuel quantities and fire intensity potential vary greatly. However, one common pattern is a peak in fuel accumulation when forests are immature due to falldown of the previous stand that was killed by fire (Brown 1975). During the midlife of the forest, fire hazard is reduced as dead fuels decay and live tree crowns grow higher above the ground. When stands become overmature and decadent, dead fuels again accumulate, and the likelihood of high intensity fire increases (fig. 2).

FIRE PROPERTIES

Any time available fuel levels and adverse weather combine, wildfire potential is high. Homeowners should be aware of how those fires would most likely spread through their property. Fires are often categorized by the type of fuels that primarily support the combustion, namely ground fire, surface fire, and crown fire (fig. 3). Ground fires are primarily smoldering combustion of compacted wildland floor material and peat. They are of minor concern to homeowners. Surface fires spread along the surface of the ground in leaves, grasses, forbs, shrubs, and fallen woody twigs and branches. Crown fires spread through the crowns of trees by torching out trees as the surface fire ignites them or by spreading through tree crowns independently of the surface fire. Crown fires are usually pushed by strong winds or aided by steep slopes. Surface and crown fires are of major concern to homeowners because they can spread rapidly, burn intensely, and generate many airborne burning embers. These fires may cause houses to catch fire and burn by producing spot fires on flammable roofs, flame contact from burning shrubs or from a surface fire in ground litter, and burning embers that may reach the interior of houses through open windows, chimneys, vents, or under the eaves and patio decks.

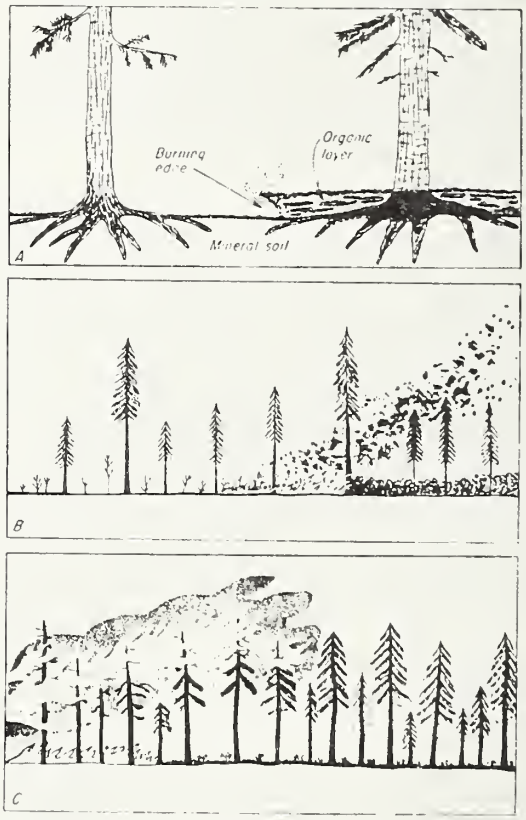

Figure 3--Wildfires are generally classified as A. ground fires, B. surface fires, or C. crown fires (after Brown and Davis 1973).

Fire intensity is the rate at which heat energy is released by combustion. Surface fires can range from low intensity, easy to control, to high intensity fires that are difficult to control. Crown fires are of high intensity and pose the greatest threat to homes. Despite modern fire-fighting technology, crown fires are almost impossible to stop until they run out of fuel or the wind stops. In a study of homes surviving bushfires in Australia, the lowest probabilities of surviving fire were associated with the highest fire intensities (Wilson and Ferguson 1986).

Flame length is an indicator of fire intensity and is considered to be the distance from the base of the flame to the tip of the flame (fig. 4). As

the amount of fuel increases, especially the fine forest fuels, the flame length increases and can trigger additional problems.

The most serious features of wildfire besides rate of spread are:

A. Torching is the burning out of an individual tree or a group of trees. Generally, low limbs with foliage ignite and support burnout of the crown. Sometimes moss or lichens carry the fire to the interior of the tree crown where accumulated fine dead fuel is consumed.

B. Crowning is the extreme case of torching where weather, wind, and fuels combine to allow the fire to advance from tree to tree with rates of spread three to eight times faster than a surface fire (Rothermel 1983). Once the fire has developed into a "running crown fire," there is little that can be done to stop it. However, earlier fuel treatment can deny the fire sufficient fuel to continue crowning.

C. Spotting is caused by the lofting of burning embers (firebrands) in the flaming column and casting them downwind where they may land on ignitable material and start a new fire. Spotting sources can be a pile of woody debris, a torching tree, or a fire front moving across surface fuels or through the crown material of shrubs and trees.

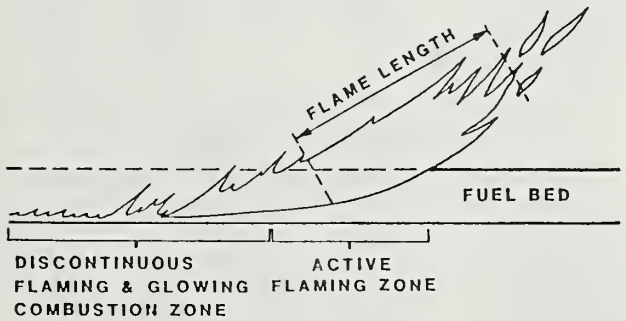

Figure 4--In the surface fire, flame length is the distance from the tip of the solid flame down to the midpoint of the active flaming zone (after Andrews 1986).

Wildfires spread primarily in fine forest fuels by a continuous series of ignitions. Rate of spread provides a measure of how fast a fire travels through the fuel. Because of the variety of conditions in which a wildfire can occur, the rate of spread can be from about 0.05 to 5 miles per hour.

For torching, crowning, and spotting to occur, there first must be an ignition; this is governed by the temperature and moisture content of fuel. When the fine fuels' moisture content is down to 8 percent OD and temperatures exceed 90 °F, the probability of ignition is equal to 50 percent or more. This means that one out of every two firebrands is capable of starting a fire if it lands in the proper fuel. If the moisture content drops to 4 percent and temperatures are above 90 °F, the ignition probability is 100 percent, a virtual certainty.

Fire Danger Index

It is important that woodland or forest dwellers be aware of the weather conditions that create fire danger to their homes and realize they will occur every year. There is available an indicator of how the fire danger is changing day by day in the National Fire Danger Rating System (NFDRS) (Deeming and others 1977). The expected burning intensity is estimated by considering the fuels, the season, and the weather and computing a Burning Index (BI) which is related to the expected fire intensity if fire occurs in the fuel type of a given area. This is most familiar on signs of Smokey Bear pointing to low, moderate, high, very high, or extreme fire danger. These levels of fire danger are related to the percent of the fire season days that are at a lower fire danger level, such as "very high" BI's are those that occur less than 10 percent of the time. "Extreme" BI's occur only 3 percent of the time or 97 percent of the BI's in a fire season are less than this value. Because climate, fuels, and current weather vary in each fuel type, the resulting BI's for each fire danger level may be different for each fuel type. Using sample areas for four common forest types in the interior West (sagebrush-grass, ponderosa pine, mixed fir, and lodgepole pine), the weather conditions at the midpoint of each manning level are shown in table 1.

Fire dangers that can threaten houses and other improvements in the wildlands are rapid spread rates, spotting, and crowning. Through these means, fire can be transported from a distant hillside to the homeowner's doorstep. Using the weather information gathered to assess fire danger, we have used the BEHAVE computer program to compute expected rate of spread, flame length, and fireline intensity (Andrews 1986) for various wildland types. The maximum fire behavior conditions that have occurred in the past 10 years are shown in figure 5 and table 2 to illustrate the full potential of wildland fire. The fire characteristics curve in figure 5 shows the results of applying fuel management practices in each forest and range fuel type examined.

SAFEGUARDING WILDLAND HOMES

There are several steps homeowners can take to reduce fire potential on their properties; reducing available fuel and decreasing flammability are discussed here. By reducing the amount of fine fuels, the rate of spread is sharply reduced. By reducing the quantity of fuel in all size classes, fire intensity and flame length are decreased so the fire can be directly attacked by ground firefighting resources. This is the objective of treating and modifying the fuels surrounding wildland homes; reduce and spread out the fuels so even fires occurring during extremely severe weather conditions are slow spreading and of low intensity. Forest dwellers may have very little time to avoid catastrophe if they wait for a fire before making preparations. It is important that all of the safeguards possible be accomplished prior to the ignition of a fire.

Table 1--Weather conditions--air temperature, relative humidity, and windspeed--are tabulated for midpoint BI's at each danger level for four NFDR zones in Idaho, Montana, and Wyoming. Each zone (polygon) has two or more NFDR weather stations reporting data over past 10 years

BI Levels	%	Air temp. °F	Rel. hum. %	Wind-speed mi/h
SAGEBRUSH-GRASSLAND				
Low	<22	71.5	43.0	4.5
Med	22-45	79.5	26.0	4.0
High	45-90	81.0	21.0	7.0
VHigh	90-97	82.0	18.0	12.0
Ext	>97	83.5	15.0	22.0
Max		93.0	5.0	43.0
PONDEROSA PINE FORESTS				
Low	<22	64.0	50.5	3.0
Med	22-45	72.5	34.0	4.0
High	45-90	78.0	27.5	5.5
VHigh	90-97	82.0	24.0	7.0
Ext	>97	85.5	20.5	8.5
Max		103.0	7.0	27.0
MIXED FIR FORESTS				
Low	<22	55.5	69.0	2.5
Med	22-45	65.0	51.0	3.0
High	45-90	71.5	42.0	5.5
VHigh	90-97	77.5	36.5	10.0
Ext	>97	79.5	30.5	12.5
Max		95.0	9.0	53.0
LODGEPOLE PINE FORESTS				
Low	<22	51.0	71.0	5.0
Med	22-45	65.0	46.0	5.0
High	45-90	68.5	35.5	8.5
VHigh	90-97	69.0	27.0	12.5
Ext	>97	65.5	25.5	17.5
Max		93.0	5.0	60.0

Because of limits on flame length, the likelihood of torching can be reduced by controlling how close the dead branchwood of trees is to the ground. If trees are pruned so that there are no branches less than 10 feet above the ground, even at "extreme" conditions there is little likelihood of torching. The maximum condition, though, would require pruning in excess of 13 feet. Pruning limbs to 18 feet above the ground will minimize torching and the generation of fire brands that cause spot fires.

Spot fires may, like a spreading fire, come to your house from a remote fire. Therefore, the homeowner must take precautions to minimize the chances for a spot fire to ignite. Spotting distances, once the windspeed is great enough to carry a firebrand, vary from less than 0.1 mile to 0.5 mile under "extreme" conditions, while the maximum distance may be more than 1 mile. When atmospheric conditions become very severe, large fires or conflagrations can occur and may develop large convection columns. Numerous firebrands can be lofted in these columns and carried by the winds several miles ahead of the fire front, as occurred in the Sundance Fire in northern Idaho

Table 2--Predicted fire characteristics for each forest type at the midpoint weather conditions cited in Table 1

BI Levels	Rate of spread mi/h	Flame length ft	Fireline intensity Btu/ft/s	Spotting distance miles
SAGEBRUSH-GRASSLAND				
Low	0.11	3.4	81	0.0
Medium	0.09	3.1	66	0.0
High	0.19	4.4	142	0.0
Very high	0.46	6.6	341	0.1
Extreme	1.33	10.7	985	0.3
Maximum	5.28	21.4	4442	0.8
Managed fuels	0.11	2.5	40	0.8
PONDEROSA PINE FOREST				
Low	0.04	2.1	29	0.1
Medium	0.06	2.5	42	0.1
High	0.10	3.1	68	0.1
Very high	0.13	3.5	87	0.1
Extreme	0.18	4.2	131	0.2
Maximum	1.26	10.8	999	0.5
Managed fuels	0.06	1.8	21	0.5
MIXED FIR FORESTS				
Low	0.01	1.2	9	0.0
Medium	0.01	1.9	23	0.0
High	0.02	2.6	46	0.1
Very high	0.05	3.5	86	0.1
Extreme	0.08	4.2	128	0.2
Maximum	0.56	11.4	1129	0.8
Managed fuels	0.09	2.0	25	0.8
LODGEPOLE PINE FOREST				
Low	0.01	0.9	4	0.1
Medium	0.03	2.3	35	0.1
High	0.04	3.2	71	0.1
Very high	0.08	4.1	120	0.2
Extreme	0.10	5.0	185	0.2
Maximum	0.73	13.1	1528	0.8
Managed fuels	0.10	2.3	34	0.8

in 1967 (Anderson 1968). Most woodland and forest dwellers have small acreages so the dimensions of their property lines are smaller than the spotting distances. The protection of their homes from spot fires and spreading fires depends on how well debris, woody residue, weeds, and grasses are cleaned up. This way, little fine fuel is available for ignition, reducing the fire potential.

Because firebrands account for the majority of burned homes, the owners must be aware of when their property would be easily ignited. An early warning is available by listening to the mid-day weather report for the temperature and humidity of the locality. The ease of igniting fine fuels like needles, dead grasses, dry cedar shakes or shingles, and old woody debris is dependent on the temperature and relative humidity. The ease of ignition or ignition probability is at its highest level when the temperature has reached its high and the relative humidity has reached its low. The critical time of the year to the wildland homeowner is when the ignition probability exceeds 50 percent. Because firebrands often occur as showers of thousands of embers, the homeowner may face an overwhelming task. Unless, of course, there has been an effort to fireproof the roof, remove flammable fine fuels in gutters, roof valleys, and under porches, and eliminate woody debris around the house. Estimates of ignition probability are shown in table 3 so the wildland homeowner can have some idea of the potential for ignition. Areas shaded by trees have lower probabilities of ignition than open sunny locations.

How can the characteristics of fuel be altered to reduce flammability? Removing fuel, particularly fine fuel, is certainly the most effective means of reducing flammability because it reduces fuel quantity and continuity. Planting less flammable species around homes can be helpful. Moisture content of live vegetation can be maintained at high levels by regular watering. Even lower rate of fire spread values can be achieved if ground litter is replaced by grasses or other moist ground covers. Establishing and maintaining green lawns, for example, can curtail spread of fire.

The effect of managing the fuels for each woodland type around woodland homes is illustrated in figure 5 and table 2. Note the values in table 2 below the maximum estimates; these values indicate the type of reduction in fire danger that can be expected with good fuel management.

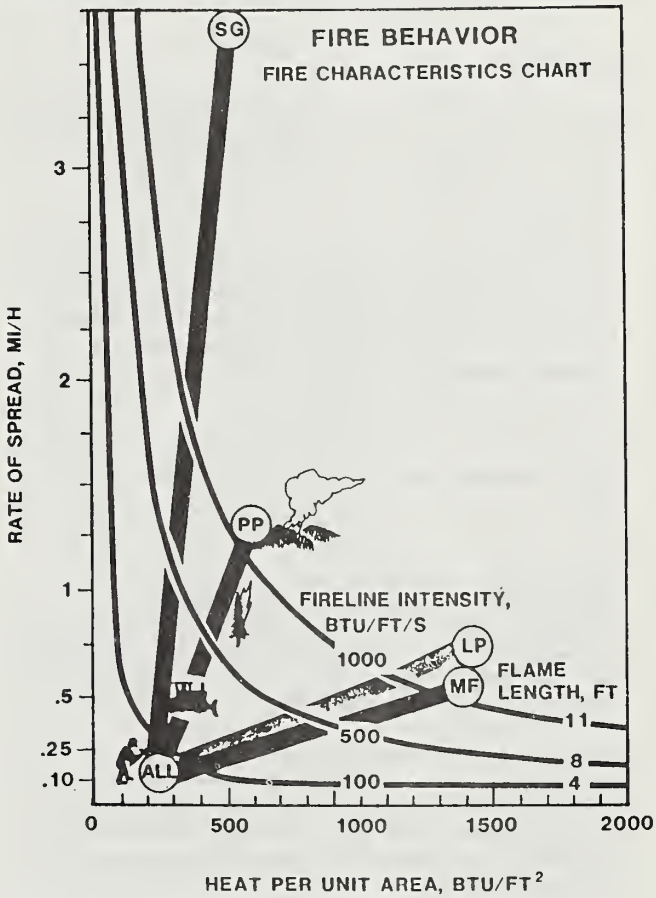

Figure 5--The fire characteristics chart shows how rate of spread and fire intensity change as fuels are modified: sagebrush-grass, SG; open ponderosa pine woodland, PP; mixed fir forest, MF; lodgepole pine forest, LP.

Table 3--Probability of ignition dependence on temperature, relative humidity, and shade

Air temp.	Relative humidity, percent													
°F	5		15		25		35		45		55		65	
	Probability of ignition, percent													
	Open	Shade	Open	Shade	Open	Shade	Open	Shade	Open	Shade	Open	Shade	Open	Shade
60	100	80	90	50	80	30	80	20	70	10	70	10	70	10
70	100	80	90	50	80	30	80	20	80	20	80	10	70	10
80	100	80	100	60	90	50	80	40	80	30	80	20	70	20
90	100	80	100	70	90	50	80	40	80	30	80	30	80	20
100	100	80	100	70	90	50	90	40	90	40	80	30	80	20
110	100	90	100	70	100	60	90	50	90	40	90	30	80	30
120	100	90	100	70	100	60	90	50	90	40	90	40	90	30

Fire prevention and control actions are often aimed at breaking continuity of fuel. Homeowners and forest managers have many opportunities for disrupting continuity by thinning, pruning, and creating fuel-free areas and by preventing continuous vegetation when planting and tending shrubs and trees.

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CULTURAL PRACTICES THAT CAN REDUCE FIRE HAZARDS TO HOMES IN THE INTERIOR WEST

Wyman C. Schmidt and Ronald H. Wakimoto

ABSTRACT: Homes in natural grass-, shrub-, and forest lands are susceptible to wildfire. Cultural practices can be used to reduce fire hazard yet maintain a natural appearance. This paper discusses the most appropriate methods to use in each of four natural settings--grass, shrub, and dwarf conifers; ponderosa pine forests; mixed fir forests; and lodgepole pine forests. Complete fire-proofing is not possible but the probabilities of losing a home to wildfire can be substantially reduced with the relatively simple procedures discussed in this paper.

INTRODUCTION

Conifer forests and grass-shrublands have had a long association with fire in the interior West. Wildfires have shaped the character of most of the old-growth forests and grass-shrublands we have today; geologic history tells us that this has gone on for thousands of years (Lotan and others 1981). Most of our western coniferous forests are well adapted to fire because of characteristics such as closed cones that protect the seeds and thick bark that protects living tissue. In fact, most of our forests owe their very existence to fire because fire creates receptive seedbeds, reduces vegetative competition, and unlocks nutrients needed by many species to regenerate and grow successfully. Much the same can be said for the grass-shrublands because fire frequency determines which species will be successful in the long term. Unfortunately, wildfires are not compatible with the objectives of most people who have a home in these natural settings--they don't want their homes burned and they are satisfied with the natural setting around their home (Fischer and Books 1977; Guth 1987).

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What can be done to help protect homes from wildfire in the interior West? There are many partial solutions to this problem including those that deal with the structure itself, access, firefighting capability, and the like. These are dealt with in other papers in this proceedings. This paper discusses how natural fuels contribute to fire hazard under various conditions and how these fuels can be modified to reduce the hazards. Included are cultural practices that modify the fuels on grass and shrublands and silviculture--the art and science of growing, tending, and modifying the forest.

Silviculture deals with two broad categories: tree establishment and culture of trees and stands that are already established. Because most people build in a particular vegetation type that already suits their lifestyle, establishment of new trees or other vegetation is seldom needed. Therefore we will focus our attention on cultural practices that modify existing vegetation to reduce fire hazard. These practices are normally used to adjust species composition, age distribution, stand density, and stand structure. The objectives are usually aimed at improving growth of trees, shrubs, and other vegetation, reducing insect and disease problems, and enhancing visual, wildlife, water, and other resource values. In this case however, the primary treatment objective is to reduce fire danger for homes while maintaining or enhancing esthetic values. Our intent is to discuss and illustrate some cultural practices that will enable homeowners to substantially reduce the risk of severe fire damage to their wildland homes (fig. 1).

VEGETATION TYPES

Four vegetation types are discussed in this paper--the grass-sagebrush-dwarf conifer woodlands found at the warm-dry end of the spectrum, ponderosa pine forests on the more moderate temperature and relatively dry climate areas, mixed conifer forests on the moist and relatively moderate temperature climates, and lodgepole pine forests on the cold-moist areas at the higher elevations. Many vegetation classification schemes are available for the interior West, but for simplification we are combining them into these four types where fire hazards are reasonably similar. All are

Figure 1--Most people who want a "home in the woods" have in mind a particular setting and vegetative type that suits their lifestyle. Unfortunately, some of these idyllic settings are extremely vulnerable to life- and property-threatening fires. Fortunately, fire hazard can be reduced and this paper describes some of the methods.

commonly found throughout the interior West and are considered desirable home sites by many people seeking "pristine" environments.

Grass-Sagebrush-Dwarf Conifer

The open vistas of grasslands, sagebrush-grasslands, and dwarf conifer woodlands attract thousands of new homeowners every year. In the interior West this land is usually less expensive than acreage in conifer forests. Alternative land uses, other than livestock grazing, are limited. Considering the poor financial health of the livestock industry in recent years, many working ranches within a reasonable commuting distance from prairie cities and towns are being subdivided out of economic necessity. This often results in small acreage "ranchettes" that either exclude grazing or allow excessive animal use that can lead to the growth of unpalatable trees and shrubs.

In the interior West grasslands occur at lower elevations, generally below dwarf conifer woodlands and sagebrush-grasslands. Fine dead fuels are abundant and support fires that can develop high rates of spread. Environmental conditions allow dead grassland fuels to dry out quickly in the late winter or early spring. Prior to green-up, man-caused fires are common in most developed areas. In the late summer or fall perennial grasses die back to ground level providing continuous fine fuels over large areas. Summer drought simply speeds up the drying process. In fact, drought following 2 or 3 good growing years generally precedes major grassland fires (Lotan and others 1981).

Sagebrush-grasslands cover approximately 100 million acres in the West. Although historic fire frequency was lower in this type than in grasslands, sagebrush-grasslands combine the flammability of fine dead grass fuels with the foliage and heavier fuels of sagebrush to produce fast moving, high intensity fires. Wildfires have been observed spreading at nearly 6 mi per hour. Sagebrush density and coverage greatly affect rate of spread and intensity (Brown 1982). When shrub crown cover is less than 30 percent, 80 to 90 percent of the spread rate is determined by the quantity and continuity of grass fuels. In cases where shrub canopy cover is greater than 30 percent, rate of spread increases dramatically. Fire intensity, the heat produced per square foot, might be increased 100 times over that of the grass fire alone. It is interesting to note that historic grazing practices and fire suppression have increased the density of shrubs on the sagebrush-grasslands.

Dwarf conifer woodlands are best exemplified by the pinyon-juniper woodlands of the interior West. These woodlands are found at elevations below the ponderosa pine zone, but above the grasslands and sagebrush. Historically, fires every few decades apparently restricted the distribution and density of these dwarf conifers to shallow, rocky soils and rough topography. For the past 100 years heavy livestock grazing has reduced grass competition and fire occurrence, allowing pinyon and juniper to invade adjacent vegetation types. The rate of invasion and tree growth is usually slow with 30-year-old trees being barely 4 ft tall. Mature stands are open and park-like with very little fine fuel within the stand. Grass growth is chemically inhibited resulting in as much as 35 percent bare soil (Barney and Frischknecht 1974). Without fine dead fuels, such stands burn only under extreme temperature, humidity, and wind speed conditions.

Ponderosa Pine

Ponderosa pine forests are considered by many as prime home building locations. They produce large trees, often grow in open parklike conditions, have a unique forest fragrance, and because they are often open-grown provide a pleasant forest atmosphere without completely obstructing the view.

At the risk of oversimplification, ponderosa pine forests come in two categories. At the lower-drier end of the ponderosa pine type, ponderosa pine generally occurs in a wide range of tree sizes and is the only significant tree species; shrubs are sparse and grass is relatively abundant. Higher elevation and moisture conditions produce a somewhat different kind of ponderosa pine forest. Here, ponderosa pine is accompanied by those species that can tolerate more shade and require more moisture such as Douglas-fir, grand fir, or white fir. These associated fir species tend to occur in thickets with a wide range of tree sizes and live crowns extending to the ground. These layers of fir trees often serve as the ladder from the forest floor to tallest trees that can convert a slow-moving surface fire to a raging crown fire. Shrubs in this forest type are usually larger and more abundant than in the drier areas.

Fuels in this vegetation type are composed of easily ignited grasses and pine needles, some shrubs that burn readily (such as manzanita), downed branches and stems, small trees with flammable crowns extending nearly to the ground, and large trees with interlacing crowns. All of these add up to a serious fire hazard but one that can be reduced through the use of silviculture.

Mixed Conifer

Mixed conifer forests include a wide variety of associated conifers. In general, this forest type occurs at somewhat higher elevations, more moderate temperatures, and greater moisture than ponderosa pine forests. Douglas-fir, white fir, and grand fir occur in various combinations with several different pines, cedar, hemlock, western larch, spruce, and other species.

Dense multi-layered vegetation characterizes this zone, including tall overstory trees such as Douglas-fir, western larch, white pine, and others. They are usually accompanied by layers of understory trees of firs, spruces, hemlocks, and others plus a copious amount and variety of understory shrubs. Grasses occur, but they are not too important as a fuel because they are usually shaded out by dense tree and shrub overstories.

These combinations produce a lot of woody material. Fuels tend to accumulate in the form of down trees. Thick duff layers, consisting mainly of old conifer needles and twigs, tend to develop in this forest type. The moist conditions reduce the frequency of fire, but the accumulation of fuels and the ladder-like forest structure make fires very dangerous in the extremely dry periods when they do occur (Freedman and Fischer 1980).

Lodgepole Pine

Lodgepole pine forests are widespread throughout the interior West. They occur most commonly at relatively high elevations and are very desirable for summer home sites and homesites near winter recreation areas. The cooler temperatures and generally moister conditions result in a more homogenous forest with fewer tree and understory species than in the mixed conifer type. Lodgepole pine usually occurs in dense stands and dominates the overstory with only occasional subalpine fir and spruce as understory trees. As a result, the multiple layers so common in the mixed conifer forest are not usually a problem in these forests. Also, lodgepole pine self-prunes readily and, as a result, there is usually a significant gap in the fuel between the forest floor and live crowns. Shrubs, herbs, and grasses are very limited and do not make up much of the total available fuel.

The cool-moist conditions here often result in an accumulation of fuel in the form of down and dead lodgepole pine, particularly in older forests where shading in dense stands killed many of the smaller trees earlier and subsequently bark beetles killed many of the larger overstory trees. Duff layers are usually fairly thin.

FIRE HAZARD REDUCTION METHODS

When a large wildfire moves into a wildland residential area the only possible way to protect every home is to place a fire engine at each home. Management of wildland fuels to protect a home from wildfire is, for the most part, a do-it-yourself proposition and a homeowner's responsibility. Group actions, through homeowners' associations, are best applied to the dissemination of fire-safety information, to management of fuels in "common" areas, and to the enforcement or rewriting of covenants to improve fire safety. In the interior West fire suppression resources are limited. When fires occur suppression forces must pick and choose among homes of varying fire receptiveness, adjacent fuels, and access. Homes chosen will likely be ones that are defensible, of fire resistant design, with adequate fuel clearance, and have easy access. Home design and access are covered in other portions of this proceedings. Here we present fire hazard reduction methods that change the kind, amount, and arrangement of fuels adjacent to homes and yet maintain a pleasing home setting.

Grassland-Sagebrush-Dwarf Conifers

Because of substantial differences in the fuels found in this type, hazard reduction methods will be described for two categories of fuel--grass and shrubs-dwarf conifers.

Grass Fuels--Grass fires generally ignite homes through direct flame contact. Fuel management should concentrate on removing grassy fuels for 30 ft around all dwellings. Mowing and raking reduces the amount of fuel, the rate of fire spread and the fire intensity. Mowing should be done periodically starting in the spring. Do not wait until late summer to mow. Many fires are started accidentally by people mowing tall, dry grass during times of high fire danger. Watering the grass to keep it green in the summer gives added protection. Some rural homeowners intentionally burn these grass fuels in the spring. Unfortunately, their limited knowledge of fire weather and fire behavior sometimes gets them into trouble. As home density increases, so does the liability for an escape fire. Contact the agency with fire suppression responsibility for your area to discuss the equipment needs, burning techniques, and hazards before lighting grass fires.

Thoughtful landscaping around the structure is an excellent way to prevent direct flame contact. Concrete or gravel walkways around buildings can eliminate fuels next to the structure. Strategically placed rock gardens using native or crushed rock are effective, easily maintained barriers to fire spread. Riding trails, walking paths, and circle drives around the structure can be viewed as additional barriers to fire. Barrier widths should be three to five times the height of the uncut grass.

Shrubs and Dwarf Conifers--As the amount of fuel increases, so does the likelihood of a home igniting from radiation or spotting. Burning shrubs and dwarf conifers produce long flame lengths radiating great quantities of energy that can ignite drapes and other items inside a home, even before the exterior of the house is ignited. This high intensity also creates rapid upward air movement that can carry burning embers onto roofs and decks. Hence fuel management objectives are to increase the distance between these fuels and the dwelling and to reduce the likelihood of a number of shrubs and trees all igniting at one time.

Cutting and thinning shrubs and dwarf conifers and removal of dead fuels is the best way to reduce fire intensity in these vegetation types. Because most of these plants do not sprout vigorously after a fire, the effects of a major cutting and thinning effort will last 10 to 15 years or more. Individual plants should be spaced so that distance between plants is at least five times plant height. Dead branches should be pruned out and disposed of. Clumps of large shrubs or trees should be reduced to individual plants. This thinning should be done for at least 100 feet from buildings. The greatest vegetation reductions should be within 30 feet of the structures. This action also makes it easier to water and mow grass in that 30-foot area around the structure.

Conifer Forests

Fuels in conifer forests commonly form a ladder-like pattern that enhances the spread of fire from the forest floor into the crowns of the main canopy of the forest. These are commonly referred to as ladder fuels and as illustrated in figure 2, the analogy fits very well. The various fuels--needles, grasses, shrubs, woody debris, understory trees, and overstory trees--are analogous to the rungs in a ladder. Removal or alteration of any of these fuels takes one of the rungs out of the ladder and reduces the hazard of a severe crown fire.

Figure 2--Fuels in this illustration form a ladder-like configuration that contributes to fire hazard. Removal of any of these fuels is similar to reducing rungs in a ladder--it makes it harder for fires to climb the fuel ladder.

Silvicultural practices can be used to reduce fire hazard by adjusting the amount and configuration of the three primary types of fuel that contribute to fire hazard: (1) live tree crowns, (2) dead organic material from standing or down tree stems, branches, needles, duff, and (3) other vegetation such as shrubs, herbs, and grasses. The same type of silvicultural practices are appropriate for each of the three forest types described earlier, but accomplishing the tasks will require different levels of effort in the different forest types.

Live Trees--Crowns of live trees are the primary source of fuel for a crown fire. Three things can be done to reduce this type of fuel: (1) thinning to separate tree crowns enough to reduce the probability of fire moving laterally from one crown to the other, (2) pruning to raise the lowest level of the crowns far enough from the ground to reduce the probability of a surface fire getting into the lower crowns of the trees, and (3) removing understory trees to reduce the probability of fire laddering from contiguous small to medium to large trees.

Thinning is an important silvicultural technique for reducing fire hazard (Coulter 1980). Thinning should remove enough trees to prevent the crowns from touching (fig. 3). In high density stands this may require removal of over half the trees--in low density stands only a few may have to be removed. To be on the safe side, a good rule of thumb is to remove enough trees to reduce crown cover to less than 35 percent with a minimum of 10 ft of open space between crowns (Dennis 1983). Crown cover is the percentage of area covered by tree crowns if one were looking at it from above (fig. 3). Retaining greater amounts of crown cover increases the probability of fires spreading laterally through the crowns.

Stands should be thinned for a minimum of 2 tree heights each direction from the home if on level terrain. If the home is on a slope the hazard increases because hot gases flow upslope, preheat the fuels, and increase the probability of ignition near or on the home (Coulter 1980). As a result, for treatments to be equally effective on slopes, treatment distances from the home must be 1½ to 2 times larger on a 30 percent and 2 to 4 times larger on a 55 percent slope than on level terrain (fig. 4). Treatment distance below the home increases from the recommended 2 tree heights on level terrain to 8 tree heights on the 55 percent slope.

Also included in the thinning operation should be the removal of those trees immediately around the home for about 30 ft in each direction if on level terrain, but, like the thinning recommendations, proportionately more for homes on slopes.

Thinning can often be done at a profit to the homeowner if the trees to be removed are large enough to make lumber, poles, posts, grapestakes, pulpwood, firewood, or other useful products. If not, some expenditure of time and money may be needed. An extension forester or consultant forester should be contacted for advice on thinning operations if the homeowner is unfamiliar with the process.

Some precautions are in order. Thinning can result in additional tree losses due to wind damage if the original stand is very dense and it is opened too wide. To reduce this problem, a two-stage thinning is advised, with the initial thinning removing about one half to two thirds of the desired amount followed by another removal 5 to 10 years later. Generally, the largest trees will be the most windfirm and, if generally healthy, should be retained as leave trees. To avoid buildup of bark beetles and fire hazard, slash created by the thinnings should be disposed of soon after thinning.

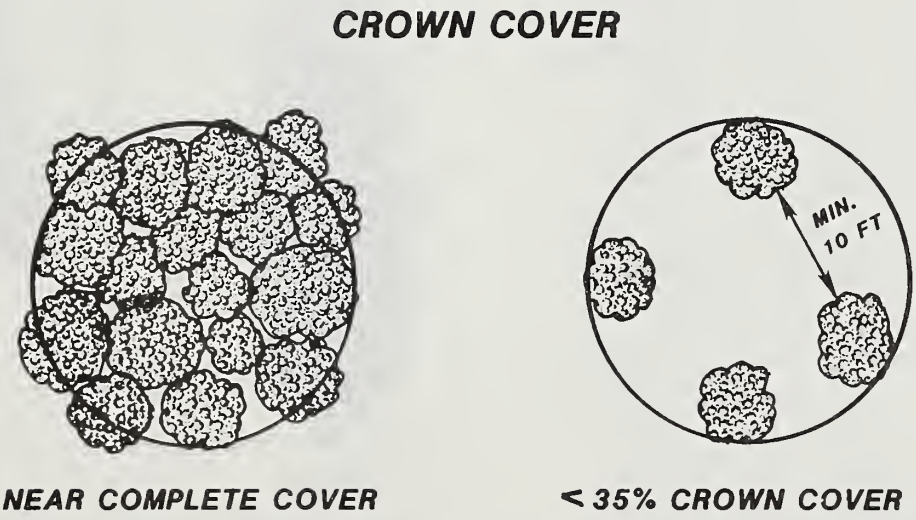


Figure 3--Stands should be thinned to reduce crown cover to less than 35 percent of a minimum of 10 ft between crowns. This greatly reduces the probability of fires spreading laterally from crown to crown.

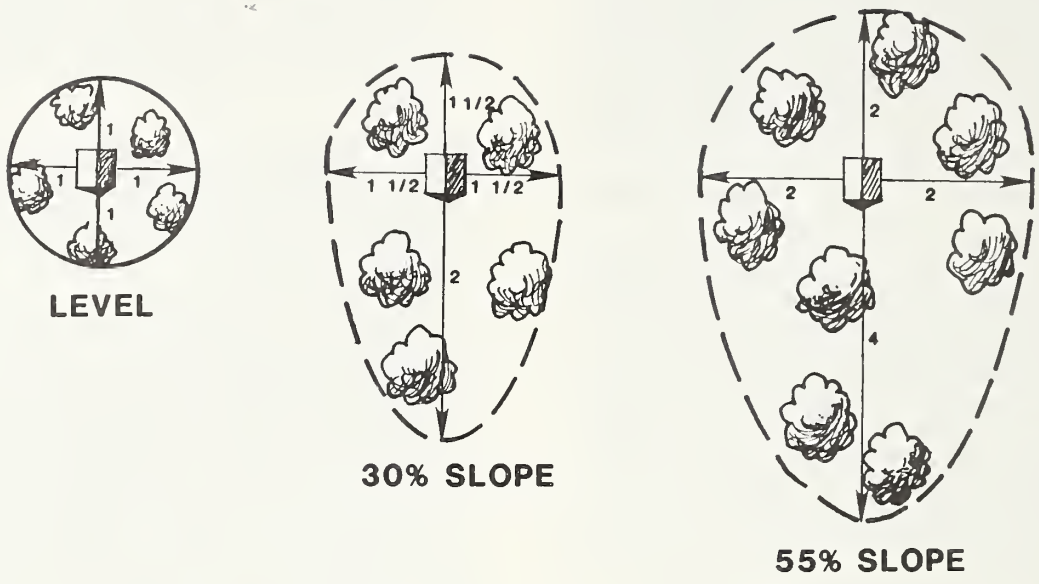


Figure 4--Increasing slopes require increased treatment distances to be equally effective. Recommended distances for level terrain should be multiplied by the factor shown. For example, to be equally effective distances downslope from the home must be increased four-fold on 55 percent slopes when compared to level terrain.

Some expected benefits, in addition to reduction in fire hazard, include an increase in tree vigor and growth, pleasing appearance of individual trees and the stand, and resistance against insects.

Pruning is another important silvicultural technique that can be used to reduce fire hazard for homes in the forest (Fahnstock 1971). For fire hazard reduction, pruning's primary purpose is to increase the distance between the lowest part of the crown and the forest floor. This reduces the probability that surface fires will spread into the crowns where they are very difficult to control. Pruning should remove both live and dead portions of the crown up to 10 ft above the ground (fig. 5) and should be done the same distances from the structure as prescribed for thinning.

Another very effective method of limiting the spread of surface fires both laterally and vertically into the main tree canopy, is removal of understory trees--usually fir trees with long full crowns that extend close to the ground. These trees are a key rung in the fire ladder between the surface fuels and crowns of the overstory trees. Without their removal, surface fires can readily spread from the forest floor to the small, medium, and large understory trees and from there to the main canopy. This connection must be severed by removing these understory trees. If the homeowner elects to retain some of these understory trees, they should not be left in clumps, should be a minimum of 12 ft apart, and should not be under the canopy of a taller tree. Treatment distances from the structure should be the same as those for thinning.

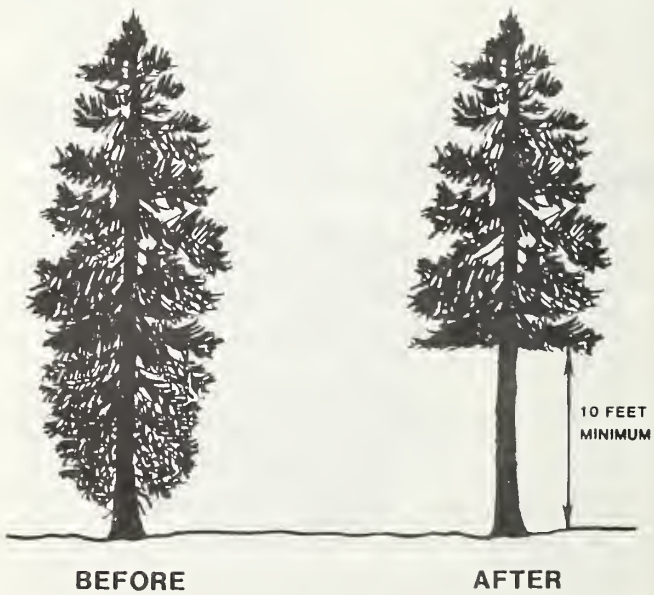


Figure 5--Pruning should remove the live and dead branches a minimum of 10 ft from the ground. This reduces the probability of surface fires spreading into the crown.

Dead Organic Material--This material is the primary fuel for carrying a fire along the forest floor. Most of it must be removed if the fire hazard is to be reduced significantly. The thinning and pruning operations mentioned in the earlier sections also contribute significantly to fuel loading, so the operations of thinning and fuel reduction should accompany each other.

Dead standing and down tree trunks should be removed. Often, these are useable for firewood. In some cases, standing dead trees may be reserved for aesthetic or wildlife purposes. If so, care must be taken to remove all flammable material near their base. Smaller branch materials should be removed from the site either by piling and burning them at a safe time of the year or physically removing them to a location safely away from the home.

Finer twigs, needles, and duff layers should be reduced. In some cases where the property is not extensive, this can be done by raking or some other method. In other cases, the best approach is to remove these fuels from around the remaining trees, then prescribe burn the area under safe burning conditions with the close direction of specialists in this type of operation. Having accomplished this successfully for the first time, periodic burning of accumulated needles and other fuels can be done much more easily because fuels will usually be less abundant. This treatment should be done for the same distance from the home as that described for thinning.

Other Vegetation--Trees, both living and dead, account for most of the fuel in conifer forests. However, other vegetation such as shrubs, grasses, and forbs also provides some fuels, particularly at certain times of the year. After the grasses, leafy forbs, and shrubs have matured, they become a hazard because fires can move rapidly through them and ignite the heavier woody fuels.

If shrubs are fairly abundant near the homes, and if they are the type that are highly combustible, such as manzanita, they should be removed or thinned so they are not near each other or near trees. This problem is most common in the ponderosa pine zone.

Grasses that mature and dry out early in the growing season can also be a significant problem, particularly in the ponderosa pine and lower portions of the mixed conifer zones. If feasible, grasses near the homes (30 ft or so) should be replaced with a watered lawn that stays succulent most of the year. If water is not available grasses should be mowed and cuttings removed once or twice during the growing season. This tends to keep grasses more succulent and removes part of the fuel ladder.

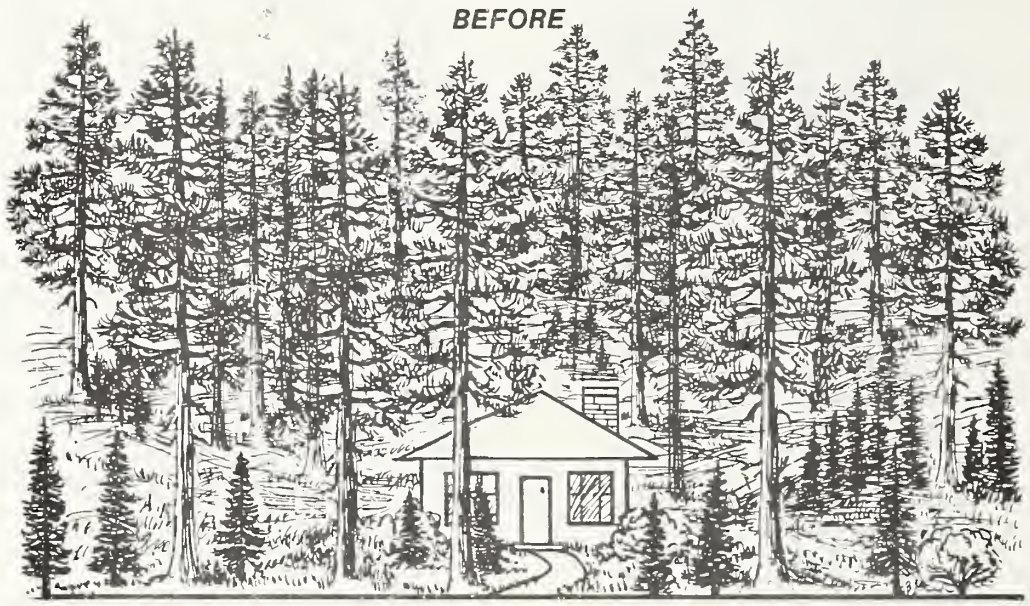
Treatment Combinations--The treatments just described alter the character of the live trees and stands, the dead organic matter, and the other vegetation. Figures 6, 7, and 8 graphically portray those combinations of treatments and show how treatment needs are somewhat different in the three conifer forests--ponderosa pine, mixed fir, and lodgepole pine.

Community Efforts

Although this paper emphasizes what individual homeowners can do in the way of cultural practices to reduce fire hazard, much can be done collectively by homeowner groups (Dennis 1983). The same principles apply to groups of homes as individual homes, but community efforts can have a compounding effect in reducing the overall fire hazard. One fruitful community effort is to develop fuelbreaks around and within subdivisions or communities (Green and Schimke 1971). This can be done in different ways. For example, fuelbreaks are generally on easily accessed strips of land that are suitable for fuel reduction treatments including thinning, pruning, removal and spacing of understory trees and shrubs, and the disposal of woody fuels. This creates an open, parklike condition that is both attractive and safer from spreading fires. Another desirable method is to convert strips of land from natural tree, shrub, and grasslands to green parkways of watered lawns. Either method can be blended in esthetically by following natural contours or existing fire access roads.

Thus, whether done individually or collectively, there are a number of cultural practices that can be used to reduce fire hazard. If designed properly, they can have the added benefits of healthier vegetation and a more esthetically pleasing natural setting.

PONDEROSA PINE



TREATMENT

THINNED & PRUNED
UNDERSTORY TREES REMOVED
SHRUBS REDUCED
WOODY FUELS REMOVED
GRASSES CUT

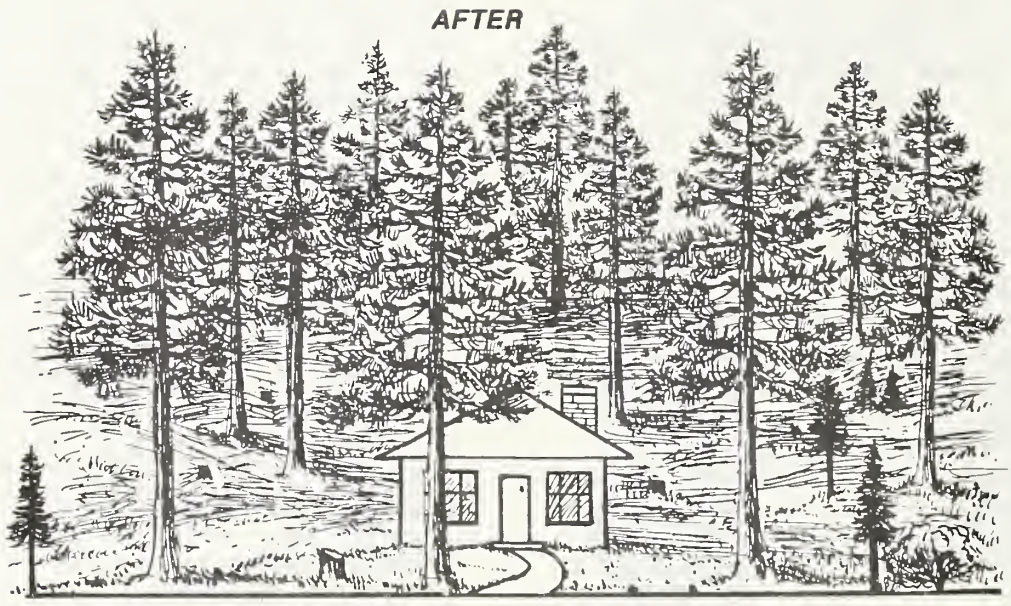


Figure 6--To reduce fire hazard, ponderosa pine forests will usually require a moderate amount of thinning and pruning, some understory and shrub removal, a modest amount of woody fuel removal, and usually grass removal or replacement with bluegrass.

LODGEPOLE PINE

BEFORE

TREATMENT

THINNED
MINOR PRUNING
WOODY FUELS REMOVED

AFTER

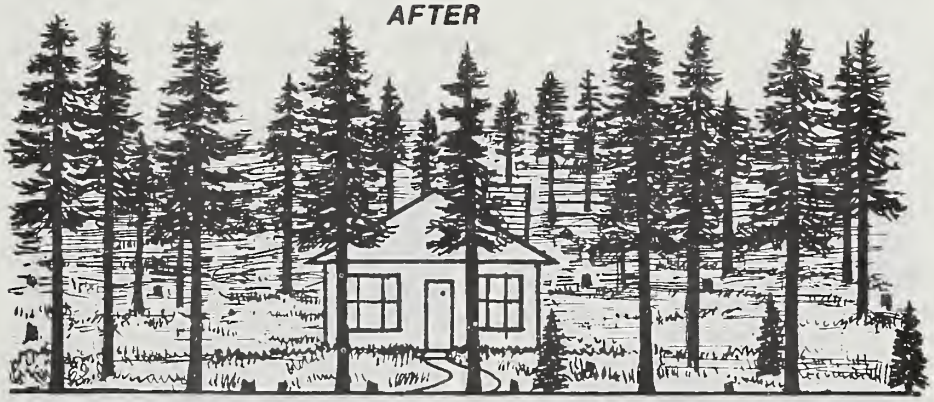


Figure 7--Reducing fire hazard in mixed fir forests normally requires a significant effort because stands are usually dense and require a lot of thinning, trees have long crowns that require a lot of pruning, understory trees and shrubs are usually abundant and need to be removed, and abundant woody material and duff need to be substantially reduced.

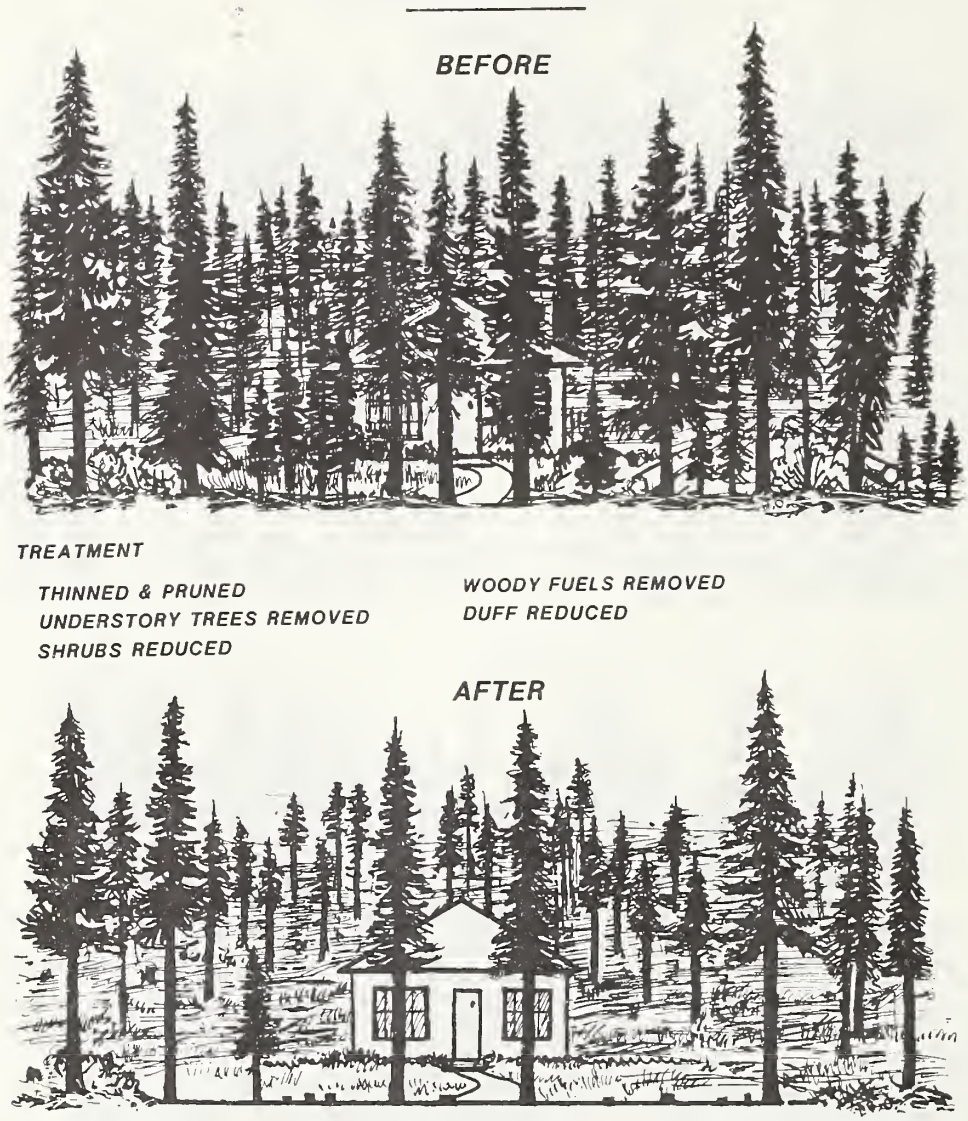


Figure 8--Reducing fire hazard in lodgepole pine forests will normally require a lot of thinning and removal of dead woody material but only a minor amount of pruning and understory tree removal.

SUMMARY

Cultural practices can greatly reduce fire hazards around homes in the grass, shrub, and forested lands of the interior West. Reducing the fire hazards will also decrease the probability of losing a home to wildfire. At this point, there is no 100 percent foolproof cure for the fire hazard headache, but the cultural practices described in this paper, along with recommendations from other disciplines, should go a long way in relieving the pain. Most of the recommendations in this paper make just plain common sense if you have an understanding of fire behavior and the fuels that feed the fire. At this point, there is no mathematical equation that can predict the probability of a home surviving a threatening fire under each and every vegetation type, fuel condition, topographic position, type of home construction, and the like. However, there is no doubt that the probabilities of a house surviving a threatening fire can be increased substantially if the cultural practices suggested here are followed.

The cultural treatments described in this paper are additive. Completion of each treatment increases the probability of home survival. For example, pruning alone is helpful but it is far more effective if it is accompanied by thinning, understory tree removal, grass and shrub treatments, and removal of tree trunks, branches, and litter. Some treatments have to be accompanied by others or they lose their positive effect. For example, thinning without subsequent slash disposal can create a higher fire hazard than no thinning at all.

In many cases, cultural practices will enhance the appearance of the homesite and the owner may adopt all the options, substantially reducing the fire hazard to his home. However, in some cases, the application of all of these recommendations may alter the character of the home site so much that it no longer meets the owner's objectives. In this case, the owner may choose to use only those stand culture practices that help reduce hazard but don't greatly alter the appearance of the stand, with the full knowledge that fire hazards may remain substantial.

In brief, the following cultural practices can be used to decrease fire hazard to homes in wildland situations:

1. Thin the forest to 35 percent or less crown cover or a minimum of 10 ft of space between crowns to reduce spread of crown fires.
2. Prune trees to 10 ft or more above the ground to reduce the incidence of surface fires getting into the tree crowns.
3. Remove understory trees or space them widely enough to reduce the chances of surface fires igniting them and they in turn the main forest canopy.
4. Clean up dead woody material including that already there, and that accumulated in the above operations to reduce incidence and intensity of surface fires.
5. Remove or widely space combustible shrubs and reduce the grasses that mature early to reduce the incidence of fast-moving surface fires.
6. Remove or thin shrubs so that the intervening space is at least 5 times the height of the plants.
7. Mow and rake up grasses periodically during the growing season to reduce the incidence of fast-moving surface fires.
8. Where collective efforts are possible, build fuelbreaks with thinning or clearing around and within communities.

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PROTECTING PEOPLE AND HOMES FROM WILDFIRE IN THE INTERIOR WEST: MEETING THE CHALLENGES

Tom Borden

I'm the wind-up speaker. When I'm through, that's the clue you can get off your duff and head for home. And then I can head for Colorado for the opening of elk season Saturday morning.

Dan Bailey asked me thank everyone who has been a participant or has sponsored this particular symposium. And so I won't forget, I will do so now. Those people and organizations include the U.S. Forest Service, the National Fire Protection Association, the Society of American Foresters, the National Association of State Foresters, the University of Montana, the Montana Department of State Lands, and Montana Extension Forestry. With special thanks to the steering committee and the program committee. And then, let me add, as an addendum, the one person who acted as the chief wrangler for this whole operation: Dan Bailey. I think everyone, including and particularly Dan, needs to receive a round of applause.

Fortunately for you, I do not have a written speech because when you're the one who has to wrap up a conference, you listen, jot a few notes, and provide a summary, and there's nothing to read. Often times, however, when I see someone come forward wearing glasses, I say 'Oh, My God, he's going to read a speech.' But I do need them to see my notes. I'll follow these notes fairly closely because if I don't, I'll get off on tangents like, for instance, the National Association of Homebuilders comparing our particular interface problem with the 50,000 people who are killed annually on the highways. And saying 'well, the rural-urban interface really isn't that big a deal, is it? But that's like saying, 'the 50,000 boys we lost in Viet Nam over 6 or 8 years doesn't compare with the 50,000 auto deaths a year, and the earthquake in California isn't much of a problem either.' I remember talking to my boss, the president of Colorado State University, about my budget request and how important it was. He looked at me and said "Tom, do you realize that the State Forest Service is only 2 percent of the university?" I was taken aback. But then I realized that just about every department of the university was 2 percent or less of the total. Regardless, the urban-rural interface is a serious and growing problem.

As I listened, the program bore a significant resemblance to how a speech is prepared. There is an attention step, a need step, a satisfaction step, which takes care of the need, a summary and illustrations, and then an action step at the end. Well, by golly, there is no point in talking about the attention step because this particular year's fire experience drew everyone's attention to the interface problem. The turnout, which I saw here, I didn't expect at all, and frankly, I didn't expect more than 25 to 50 people to be here for the last hour of this last session. And here you are. I'm impressed, and I know that we, who are on the last day, thoroughly appreciate your staying with us. Another thing I noticed in this audience was the rapt attention that you folks paid to the speakers. Many of the programs' presentations were just superb, others were not as superb, but there you sat, listening to every word, many of you taking notes.

Well, that takes care of the attention step. The need was obviously there for the same reasons. There were people who were saying 'there's got to be a better way of dealing with the interface problem'. We have got to avoid the "Chinese firedrill" that my people and I went through. I can't imagine a conference being more timely than this one. The need is there. In fact, when I arrived Sunday from Kalispell, a great plume of smoke hung over Agnes Creek on the outskirts of Missoula. It was a fitting beginning to this conference.

What can be done to satisfy the need? Or, in other words, what's the solution to the problem? Your heads ought to be full of ideas on what to do when you get home.

We listened first, as I considered it, to the background and the considerations, the political scene--Senator Melcher and Representative DeFazio. Let me add as an aside, with all my years of experience in listening to Senator Melcher, do not hold your breath while he gets money for the fire program. Being retired at this particular time, on my own and living in another state, I can make that statement. There was the role of the Federal Emergency Management Agency. And another aside: don't hold your breath with that outfit either, because they don't produce but rarely. They

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Closing Remarks made at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Tom Borden is Vice President, American Forestry Association, Fort Collins, CO.

compare our fire interface problem with earthquakes, big floods, and hurricanes. When it gets down to some piddly little fire that only costs a million dollars, well, 'we really don't see an emergency.' That's FEMA's frame of reference. Wildland home insurance was another important aspect of the program of these last three days.

Nevertheless, what can be done? And in a nutshell, I wrote this down, "Only local citizens, wildland homeowners in particular, can bring about firesafe conditions.' I learned long ago, especially as a forester, you never say never, you never say only. But, generally speaking, I think that's the message that came across. We must build from the grassroots, the people on the ground, if we're going to actually get something done in this particular endeavor. If you have the grassroots support, only then will the local, state, and federal governments respond. The Missoula County Commissioner advised that a coalition of people meet, discuss solutions, and come up with a plan of action for whatever it is they want. In this interface case, it would include homeowners, realtors, and firemen.

Gaining the grassroots support and demands for action led to the 'how-to's'. Real life examples presented by the Lee, Severson, and Hodgson team, Montague and LaBlanc on the Sierra front, video tapes of various programs, and the successes in the various states here in the West, were followed by examples of workshops helping homeowners and developers understand how to communicate with politicians, with the media, and how to obtain consensus in methods of protecting the interface properties. And, this morning's presentations of former secretary Rupert Cutler's population dynamics, followed by the identification and role of various planning and zoning devices relating to the interface situation were important facets. A case was made for voluntary adoption of, and voluntary compliance with, firesafe practices and other desirable conservation purposes. One illustration highlighted the progress in Jefferson County, Colorado, emphasizing the regulatory aspects and the outstanding cooperation between the county and State Government. We also heard about the architectural concerns and practices, the positive and negative stances towards the interface by the National Association of Homebuilders, and the opportunities for utilization of fire engineering specialists.

But one condition, and these are my personal comments, was presented which needs a little further elaboration. If there's a limiting factor, I suspect this may be the one. Can anyone remember the first four letter word they learned? Right after 'Mommy' and 'Daddy'? It starts with the letter "M". I'm not going to play games with you. The word is MINE. M-I-N-E. My mommy, my daddy, my bottle, my bed, my wagon, my books, my school, my team, my job, my agency, my company, my authority, and, as you grow older, my responsibility.

A mother looks out at little children playing in the back yard and says "Share, quit that fighting--share." And one child says, "You touch my GI Joe one more time and I'll bust you in the nose. He's mine!" It reminded me of two vultures. Some cartoonist drew two vultures with red eyes and, of course, they were all black. He didn't know they were scavengers, portraying them as raptors. These birds were perched on a tree limb and one says to the other "Patience, hell, I'm going to go kill something." That's kind of what I think of when I think of 'mine.' Now, you may say, "Oh, for Pete's sake, we're going to get into the turf bit again; we've heard enough about that. No, I'm not going to give you a similar lecture, for, you see, competition and turf is at the heart, the very center, of our American way of life. Without it, we as a nation could not have survived for 200 years. In the city of Fort Collins, we have the Colorado State University with it's own little police department. Then there is the City Police force. The Sheriff has his boys out on the county roads, and the State Highway Patrol does it's thing on the interstates and the state highways. Every one of them says to the other "You keep the hell out of my jurisdiction." What a waste of money! Except, honestly, I hope they continue to do it. An alternative, in our very, very expensive way of life in the United States, is to have an all encompassing state-run police force. It doesn't take much thought to realize that the federal government could do it, too; one federal police force doing everything. Think of the money we'd save! I hope they never get together. I hope they fight turf battles forever and ever. But there are other, more positive examples.

Before World War II the Department of the Army and the Department of the Navy would go before the appropriations committees in Congress, and they'd fight. The Navy would ask for more aircraft carriers. And the Army generals would come along and say, "Aircraft carriers, hell, we need tanks." Neither military service was successful. Broomsticks, for instance, were used for rifle training. But look at them now! They're part of the Department of Defense. Army, Navy, Air Force, Marines. Coast Guard, I guess, is in there, too. And, would you like to know, have you any idea what their budget and their appropriations are? I don't know, but it's the biggest item in the national budget. You know, the dollars spent for one wing of a fighter could do a lot in the interface. The services are together but they're able to maintain their identity. They're still competitive but they're together and they work together, like it or not. And, they have all the money they need, maybe more than they need.

Back to Colorado. We have Colorado State University, Colorado University, Colorado School of Mines, University of Northern Colorado, and others. They used to fight without great success for funds in competition with each other before the legislative budget committees. Finally, a Commission on Higher Education has been given the teeth to be the overseer of the university system. I'll bet you any amount that over the next five years, the appropriations for higher education and individual institutions will increase significantly over the levels of 1987.

We have a mountain pine beetle problem in Colorado. In the 70's, hundreds of thousands of trees were dying. And we, as individuals and agencies, the State Forest Service, the U.S. Forest Service, the BLM, and others, were all trying to fight it alone. We didn't start to win until we all got together, the homeowners, the U.S. Forest Service, the State Forest Service, the County Commissioners, and even the city of Boulder in this case. An interface team, as it related to mountain pine beetle, bore fruit you can't imagine. Comparatively, we had money coming in from all quarters, and we worked together to ameliorate the situation. Notice I didn't say we cured the problem. But we sure put a crimp in it. One of the practices we used was to cut infested trees that were becoming the hatchery for the next year's beetles, cutting and bucking them up, putting them under plastic, and injecting ethylenedibromide in a fumigation process. It worked very well. But one landowner in one little mountain community, said "I don't believe in control, it's part of nature's way." He went to church one Sunday morning, and that afternoon when he returned home, his trees were gone. The neighbors had taken care of the problem, announcing "you're going to be part of the game."

Well, mountain pine beetle was a crisis situation and the interface is a crisis situation, too. And it can be addressed in much the same way. Now, my charge to you as I get down towards the end of my comments, is as follows: Armed with what you've learned, and enthused as you obviously are, with the possibilities you've discovered or had reinforced, and recognizing that the folks back home haven't been here and will need to be informed and convinced, you must become a leader. You need to get together with others attending this meeting with you from your community or your region or your area and ask "What is it we can do?" If you can't be THE leader, be A leader, or be a catalyst, to bring about some sort of direction to the interface problem. Put together a team and make it MY team. Do what Stauber is going to do on the San Bernardino National Forest, or Hammond in the Black Hills. They're going to put together symposiums like this one. They'll get the local people involved, and maybe some outsiders, to come in and do some of the things that have been done at this particular session. It won't be easy, but when when you run into roadblocks, and you become discouraged, and ill at ease, and defeated, why don't you use the motto that I've used all my career, and sometimes it works: "Some things are impossible; others take a little longer."

SESSION 7--POSTER PAPERS

William C. Fischer, Coordinator
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FIGHTING FIRE WITH FIRE

Theodore E. Adams, Jr., Gary Reece, and Walter L. Graves

ABSTRACT: This illustrated presentation, using an animated (TV video tape) and static (enlarged color photographs) format, shows how a Southern California community used prescribed fire to reduce a wildfire hazard at the boundary with chaparral brushlands. Included is a brief narrative describing the situation and the cooperative effort needed to achieve success and reduce potential property losses and possible loss of life.

In three successive years, Tierrasanta, a southern California community near San Diego, was threatened by wildfire. This suburb borders chaparral brushlands where the risk from wildfire is great. The fires came dangerously close, but each time they were suppressed through the efforts of local fire agencies and the California Department of Forestry and Fire Protection (CDF).

In 1982, homeowners in the El Dorado Hills area of Tierrasanta decided they had had enough! Through their homeowners' association, they solicited help from local and federal politicians.

In searching for a solution to the wildfire hazard, reduction of the fuel load by mechanical and chemical brush control measures was considered and discarded. The alternative selected was prescribed fire--fire used as a tool under controlled conditions to achieve a particular management objective.

The selection of fire was appropriate, because fire is a natural tool. Chaparral brushlands are a product of fire; over several millions of years, fire has influenced the development of California brushlands.

The political contacts arranged for project funding, and the Watershed Division of San Diego County's Department of Agriculture organized the prescribed fire. The fire was conducted under weather conditions that permitted a safe burn, burning away from homes and into the brush.

The cleared area, now a fuel break, was burned for less than $10 per acre, cheap insurance for the $150,000 homes it will protect for several seasons.

Creating the El Dorado Hills fuel break produced another benefit; it provided an opportunity to train local fire protection agencies in the use of prescribed fire for fuel management. Fire fighters from four communities and a military installation participated. They were supported by state and local groups experienced in fighting wildfires, the California Conservation Corps, and the City of San Diego's Wildland Fire Fighters.

Prescribed fire for reduction of the wildfire hazard on private lands in California has been in use since creation of the Chaparral Management Program (CMP) in 1980. This program, part of the more comprehensive Vegetation Management Program administered by the CDF, emphasizes fuel management for hazard reduction. But it addresses other needs as well: watershed protection, wildlife habitat improvement, and range forage improvement for livestock production. Use of fire for the latter provided the foundation on which the CMP is based.

The CMP targets about half the 10 million acres of California shrublands for which the CDF is responsible. Making this vast area less subject to devastating wildfires is a formidable task. But the CDF is addressing this challenge through burning on a rotating schedule to create a mosaic of different age classes. Sustaining momentum of the new program is another challenge. This will depend on public support. And this can be achieved only with an investment in education.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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HELP WITH MAKING CROWN FIRE HAZARD ASSESSMENTS

Martin E. Alexander

ABSTRACT: This paper offers some suggestions and field guides with respect to the operational application of C. E. Van Wagner's (1977. Can. J. For. Res. 7: 23-34.) theory to calculate the threshold conditions for the start and spread of crown fires in conifer forests. Three categories of crowning are recognized (passive, active, and independent); they are determined by three crown fuel properties (live crown base height, foliar moisture content and bulk density) and two characteristics of fire behavior (spread rate and surface intensity).

INTRODUCTION

Three main types of forest fire are commonly recognized on the basis of the fuel layer(s) involved in the combustion process:

- Ground or Subsurface Fire
- Surface Fire
- Crown Fire

Although they may appear to spread independently, crown fires advance through the crown fuel layer normally in direct conjunction with a surface fire. Crowning forest fires are very exciting natural phenomena but pose a potentially serious threat to life and property in wildland areas (Rothermel and Mutch 1986; Webster 1986; Wilson and Ferguson 1986; Abt and others 1987). The transition from a surface fire to a crown fire is also obviously of great significance to fire managers since crowning generally represents a level of fire behavior that normally precludes any direct suppression action. The conditions under which crown fires are likely to occur have been identified in a general way (Beale and Dieterich 1963; Fahnestock 1970; Rothermel 1983). More fundamental knowledge about the physics of such wildfire phenomena in the wildland/urban interface has recently been identified as a critical fire research need (Davis and Marker 1987). In the meantime, what information is currently available now to assist land managers with the job of objectively appraising the likelihood of crown fire development on an area or site-specific basis? More than 10 years ago, Van Wagner (1977) proposed some simple theory, supported in part by empirical field observations, regarding the conditions for the initiation and sustained propagation of crown fires in conifer forests which could be applied to a variety of fire management issues, including the wildland/urban interface problem. The purpose of this paper is to outline, in practical terms, the possible application of Van Wagner's crown fire classification scheme and model to the task of evaluating crowning potential. This includes the author's synopsis of Van Wagner's theory (with a minimum of equations), supplemented with several graphical and tabular aids to facilitate the interpretation of the theoretical concepts, designed with the fire manager in mind[1]. However, a certain level of familiarity on the part of the reader with the science of wildland fire behavior and the art of its prediction is assumed. Van Wagner's (1977) journal article should of course be consulted for clarification of any technical details given here. The International System of Units (SI) is used throughout; a list of SI-to-English unit conversion factors is included near the end of the paper. However, the English unit equivalents of all equations are given.

BACKGROUND INFORMATION

Fire intensity as used in this paper refers to frontal fire intensity (I), which is synonymous with Byram's (1959) fireline intensity (Merrill and Alexander 1987), defined as "the rate of heat energy release per unit time per unit length of fire front" (Merrill and Alexander 1987). The equation used to compute I (kW/m or Btu/sec/ft) is as follows (after Byram 1959):

$$I = \frac{HWR}{60} \quad (1)$$

where, H = net heat of combustion (kJ/kg or Btu/lb), W = quantity of fuel consumed in the active flaming front (kg/m^2 or lb/ft^2), and R = linear rate of spread (m/min or ft/min). Flame length (Alexander 1982, p. 351, figure 1) is generally considered a surrogate measure of frontal fire intensity. The most commonly accepted equations are (from Alexander 1982 and Byram 1959, respectively):

$$L = 0.0775(I)^{0.46} \quad (2)$$

$$L = 0.45(I)^{0.46} \quad (3)$$

where, L = flame length (m and ft, respectively) and I = frontal fire intensity (kW/m and Btu/sec/ft, respectively).

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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[1]Enlargements and English unit versions of Figures 1 to 5 plus the Appendix are available upon request from the author at the following mailing address: 5320 - 122 Street, Edmonton, Alberta, Canada T6H 3S5.

VAN WAGNER'S CLASSIFICATION SCHEME AND MODEL

Classes of Crown Fire

According to Van Wagner (1977), crown fires in conifer forests can be classified according to their degree of dependence on the surface phase and the criteria could be described by several semi-mathematical statements. Approximate definitions for the three types of crown fires are as follows:

Passive Crown Fire - A fire in which trees "torch" as individuals, but rate of spread is controlled by the surface phase.

Active Crown Fire - A fire that advances with a well-defined wall of flame extending from the ground surface to above the crown fuel layer.

Independent Crown Fire - A fire that advances in the crown fuel layer only; the surface fire of course lags some distance behind the leading edge of the crowning phase.

Other crown fire terminology exists (for example, Brown and Davis 1973; Merrill and Alexander 1987). A passive crown fire is basically not that different from an intense surface fire and probably most crown fires are of the active class (Van Wagner 1983). The class of crown fire to be expected in a conifer forest on any given day, according to Van Wagner (1977), depends on three simple properties of the crown fuel layer and two basic fire behavior characteristics:

- Initial Surface Fire Intensity
- Foliar Moisture Content
- Live Crown Base Height
- Crown Bulk Density
- Rate of Fire Spread

The first three quantities determine whether a surface fire will ignite the coniferous foliage. The last two quantities determine whether or not a continuous flame front can be sustained within the crown fuel layer.

Conditions for the Onset of Crowning

Van Wagner (1977) postulated that vertical fire spread will occur in coniferous forest stands when the surface fire intensity (I_s) attains or exceeds a certain critical surface intensity for crown combustion (I_o) value (kW/m or Btu/sec/ft). That is, when $I_s \geq I_o$, torching or crowning is quite possible. Whereas, when $I_s < I_o$, a surface fire is likely to be the result. Ladder or bridge fuels must presumably be present in sufficient quantity to intensify the surface fire appreciably as well as to extend the height of the flames (Quintilio and others 1977). The SI or metric unit version of the equation to calculate I_o (kW/m or Btu/sec/ft) is as follows (after Van Wagner 1977):

$$I_o = [0.010\ LCBH(460 + 26\ FMC)]^{1.5} \quad (4)$$

$$I_o = [0.0030976\ LCBH(197.90 + 11.186\ FMC)]^{1.5} \quad (5)$$

where, LCBH = live crown base height (m or ft, respectively) and FMC = foliar moisture content (% oven-dry weight or ODW basis). LCBH refers to the distance from the ground surface to the base of the live conifer tree crowns and FMC refers to the moisture content of coniferous tree foliage. Equations (4) and (5) define the amount of energy required to preheat the unburned coniferous foliage to ignition temperature. Graphical representations of equation (4) are given in figures 1A and 1B. Note that the surface fire intensity required for ignition of coniferous tree crowns increases with FMC and HLCB. The importance of moisture content with respect to the ignitability of coniferous tree foliage has been demonstrated many times in the laboratory (see, for example, Fuglem and Murphy 1979; Cohen and others 1987). If the FMC is high, combustion efficiency is reduced and greater amounts of energy are required to bring the foliage to ignition temperature. However, it appears from figure 1A that the natural variation in LCBH would allow for a much greater effect on the flammability of coniferous tree foliage than would the observed variation in FMC (cf. Fuglem and Murphy 1980, p. 35, figure 10). Since frontal fire intensity and flame length are known to be directly related, it is possible, by combining equations (2) and (4) [or (3) and (5)], to infer a critical or minimum flame length for crown combustion L_o (fig. 2). According to figure 2, the flames of a surface fire do not have to necessarily reach into the tree crowns to initiate crowning; flame height and length are only equal in the case of no wind or slope (Alexander 1982).

Conditions for Sustained Crown Fire Spread

Presumably some conifer stands are simply not prone or susceptible to sustained crowning because of their low tree density and/or crown fuel density (that is, there is insufficient coniferous tree foliage to support continuous horizontal fire spread in the crown fuel layer). Passive or intermittent crown fires are common, for example, in sparsely-stocked black spruce stands even though the tree crowns extend to the ground surface (Norum 1982). The torching which occurs in a passive or intermittent crown fire simply reinforces the spread rate (that is, the crowning phase of the fire is dependent on the surface phase, the spread of which will control the fire's spread rate as a whole).

What kind of forest is most likely then to support an active crown fire? Presumably there must be sufficient surface fuel to support a substantial surface fire in order to induce crown combustion. Thereafter the surface and crown fire phases advance as a linked unit, but are dependent on each other (Van Wagner 1977). In an active crown fire, both phases contribute significantly to the spread rate. Intuitively one would think that there must be a more or less critical value or threshold condition which must be exceeded in order to sustain a continuous flame front within the trunk and crown space. Van Wagner (1977) theorized that the bulk density of the crown fuel layer must have a lower limit below which active crowning cannot be maintained (fig. 3). This thought has been formulated into the following relation (after Van Wagner 1977):

$$R_o = 3.0/CBD \quad (6)$$

where, R_o = critical minimum spread rate for active

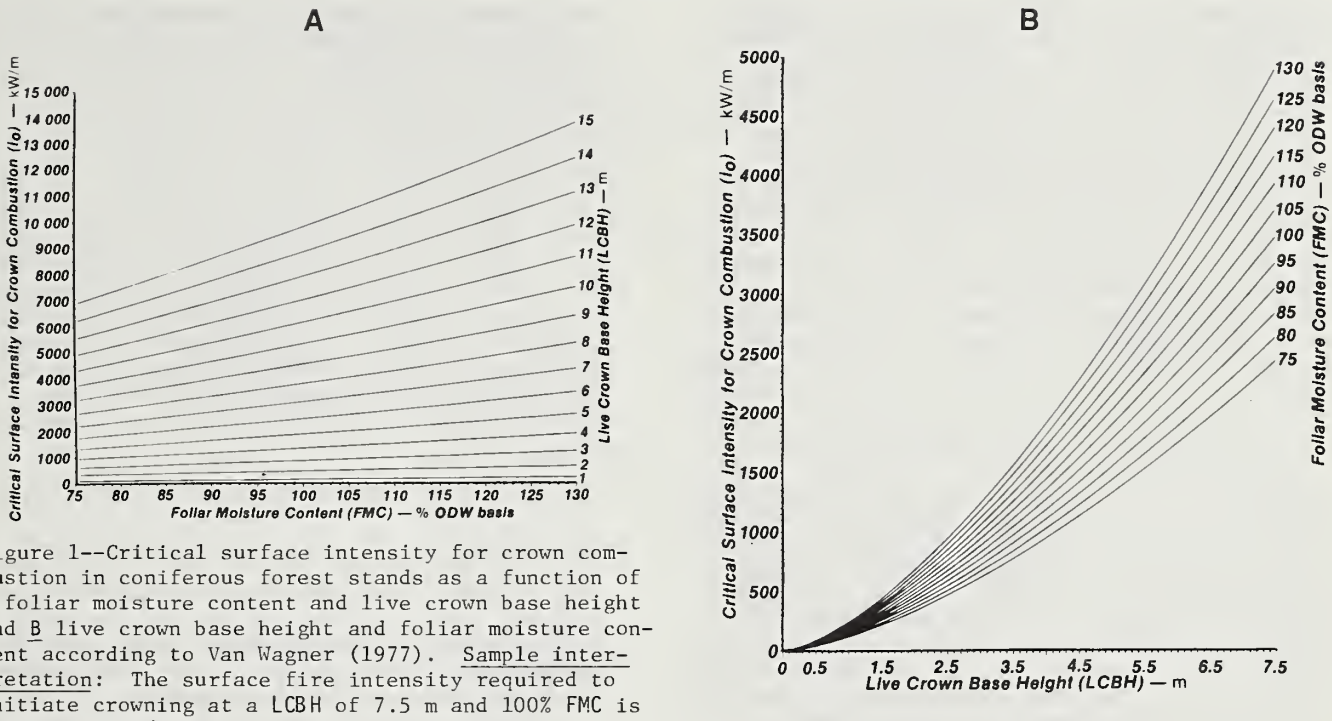

Figure 1--Critical surface intensity for crown combustion in coniferous forest stands as a function of A foliar moisture content and live crown base height and B live crown base height and foliar moisture content according to Van Wagner (1977). Sample interpretation: The surface fire intensity required to initiate crowning at a LCBH of 7.5 m and 100% FMC is about 3500 kW/m.

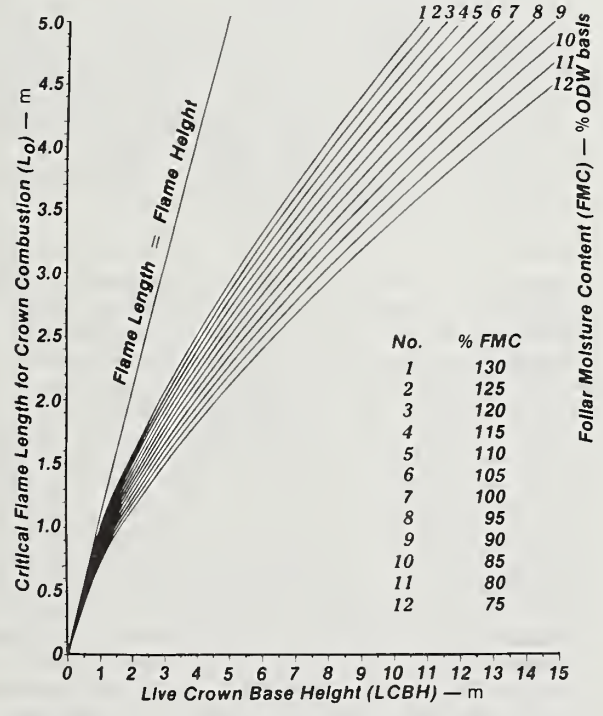

Figure 2--Minimum flame length for crown combustion in coniferous forest stands as a function of live crown base height and foliar moisture content based on Van Wagner (1977) and Byram (1959). The line of exact agreement between flame length and flame height is noted for reference purposes. Note that the key to the family of FMC curves is given in the accompanying tabulation. Sample interpretation: At a LCBH of 5 m and 100% FMC, crowning would commence once the surface fire began to generate flame lengths of 2.5 m.

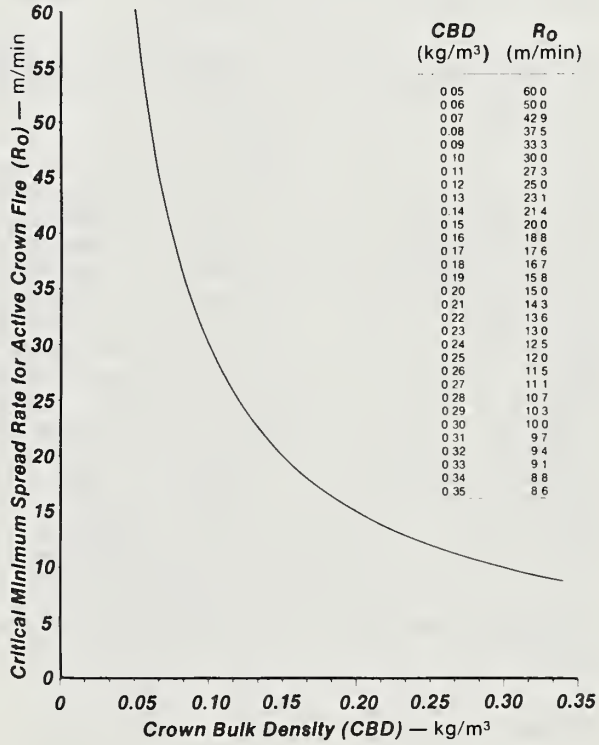

Figure 3--Theoretical relation between the critical minimum spread rate for active crown fire and crown bulk density in coniferous forest stands according to Van Wagner (1977). A tabulation of CBD and the corresponding R_o values in also given for the convenience of field users. Sample interpretation: The development of an active crown fire would not be possible at a CBD of 0.23 kg/m^3 until the rate of spread after crowning exceed 13 m/min.

crown fire (m/min) and CBD = crown bulk density (kg/m^3). To compute R_o in either ch/hr or ft/min and CBD in lb/ft^3, the coefficient in equation (6) becomes 0.55861 or 0.61446 respectively, rather than 3.0. Note that the minimum spread rate required for active crowning increases as the bulk density of the crown fuel layer decreases (fig. 3). In the simplest case, the bulk density of the crown fuel layer in a coniferous forest stand is determined by dividing the foliage weight (kg/m^2 or lb/ft^2) by the average live crown length (m or ft). This assumes that only the conifer needles are involved in the crown fire propagation process and that they are uniformly distributed throughout the overstory canopy. The CBD determination is obviously somewhat more complex in immature and disease/insect-killed stands (Stocks 1987a, 1987b) since dead twigs and some branchwood may also become available for combustion. The development of an active crown fire does not occur in a single vertical lift but climbs progressively into the crown with its forward spread as illustrated, for example, by Geddes and Pfeiffer (1981, p. 10). Once the fire crowns, the flame front will be nearly vertical within the trunk space. Deflection by the wind field may begin within the crown fuel layer and be most pronounced above the tree crowns (see, for example, Van Wagner 1968, p. 16, figure 11). Active crowning will then continue provided that the rate of spread is fast enough to maintain a continuous flame in the crown phase (that is, when $R > R_o$) and the fire can transfer enough heat to the unburned tree crowns ahead to maintain continuous ignition.

Development of a truely independent crown fire on flat topography most certainly must require strong surface winds. This is necessary in order to achieve the direct flame contact and forward radiation heat transfer through the crown foliage, that is required to continue the propagation in a horizontal dimension, more or less independent of the surface fire energy output rate. In mountainous terrain, slope steepness no doubt compensates for the reduced wind flow; as for example, a 60% slope would result in about a 7-fold increase in rate of fire spread (see, for example, Lawson and others, 1985, p. 12, figure 6), and at least a corresponding increase in fire intensity compared to the same fuel and weather conditions on level terrain. Instances of independent crown fires have been reported (Rothermel and Mutch 1986). Sustained "runs" are undoubtedly a very rare event due to the natural variations in wind velocity, fuels and terrain. In certain forest cover types with very light surface fuel loads, such as the Ocala sand pine forests of north-central Florida, wildfires would appear to spread as an independent crown fire or not at all (Cooper 1973).

FIELD APPLICATION

On the basis of Van Wagner's (1977) crown fire model, a set of graphs and tables that relate I_o and L_o to LCBH and FMC were prepared following the present author's attendance at the S-590 Fire Behavior Officer (FBO) [now Fire Behavior Analyst or FBA] training course held at the USDA Forest Service's National Advanced Resource Technology Center (NARTC), Marana, Arizona, in December 1979 (Rothermel 1983, p. 107). One of the graphs was then included in Appendix F of Rothermel (1983, p. 142, figure F-1) but no adequate credit was given to the original Van Wagner (1977) contribution. This graph was subsequently reproduced by Keown (1985) and included, along with the tables, in the FBO or FBA and Fire Behavior for Managers (FBM) Field References issued by NARTC since 1983. Tabulated versions of figures 1 and 2, for quick reference in the field, are appended to this paper (Appendix). These decision aids are based on equations (2) and (4). Some guidelines with respect to satisfying the five input requirements in the field application of Van Wagner's (1977) crown fire theory follow. Two worked-out examples of Van Wagner's (1977) model, based on data given in Quintilio and others (1977) and Newstead and Alexander (1983), are also summarized in table 1 for reference check purposes.

Spread Rate (R) and Surface Fire Intensity (I_s)

The prediction of R and I_s would consider most of the known variables that influence fire behavior (i.e., air temperature, relative humidity, wind, fuel load, fuel moisture, slope, fuel arrangement, condition of herbaceous vegetation, etc.). There are basically five approaches to obtaining decent estimates of these two parameters:

- mathematical model such as the **BEHAVE** system or similar method (Rothermel 1983; Andrews 1986);
- empirical-based system (Hough and Albini 1978; Lawson and others 1985);
- comparison with known wildfire case histories (Geddes and Pfeiffer 1981; Simard and others 1983; Rothermel and Mutch 1986) or experimental fire case studies (Quintilio and others 1977; Newstead and Alexander 1983; Stocks 1987a, 1987b; Alexander and De Groot 1988);
- recent on-site observations of fire behavior (e.g., Norum 1982); and/or
- experienced judgement.

Although the intensity of the surface fire required to support a crown fire can be specified, the prediction of surface fire rate of spread and frontal intensity is, in fact, probably more difficult to predict than the level of crown fire behavior, given the most infinite variety of possible forest floor and understory fuel complexes. The rate of spread after crowning must exceed R_o, or nearly so, in order to maintain an active crown fire. Van Wagner's (1977) model does not predict the spread rate after crowning has taken place. However, the recent work by Albini and Stocks (1986) suggests that a physical model for the prediction of crown fire rate of spread may soon be available for adaptation to field use. The effect of crowning on the overall fire spread rate is accounted for directly in the rate of spread component equations of the Canadian Forest Fire Behavior Prediction System (Lawson and others 1985). One possible approximation that could be applied to the various methods of quantitative fire behavior prediction used in the U.S. (Andrews 1986), which are technically restricted to fire spread in surface fuels, is to fully or partially adjust the mid-flame wind to the standard 6.1-m [or 20-ft] open wind speed value if crowning is anticipated on basis of the predicted initial I_s (Anderson 1983; Simard and others 1983).

Table 1--Application of Van Wagner's (1977) crown fire model to two contrasting situations

Item	Unit	Case A	Case B
Fuel type	-	Pine stand	Spruce stand
Predicted spread rate (R)	m/min	1.0	7.5
Predicted fire intensity (I)	kW/m	620	4230
Foliar moisture content (FMC)	%	117	109
Live crown base height (LCBH)	m	4.4	1.4
Crown bulk density (CBD)	kg/m^3	0.15	0.38
Critical surface intensity for crown combustion (I_o)	kW/m	1913	313
Critical minimum spread rate for active crown fire (R_o)	m/min	20.0	7.9
Type of fire	-	surface	active crown[1]

[1]Developing.

Foliar Moisture Content (FMC)

A seasonal cycle in the moisture content of coniferous tree foliage has been identified by several investigators (table 2). Twenty to 40-percentage point differences, within a range of about 75 to 130%, have been documented. Diurnal variation in FMC is also known to exist (Philpot 1965), but is probably insignificant in terms of real noticeable differences in fire behavior. At least in eastern and northern North America, a marked moisture decrease in the moisture content of 1+ year-old needles, which constitutes the bulk of a tree's foliar dry weight, is evident in the spring just before flushing of the new growth. As this new growth continues to develop, the moisture content of the older foliage gradually increases. FMC is generally highest in the late summer or early fall when all the new growth has fully developed. Similar trends have also been reported in northern Siberia (Kurbatskii 1972). The low spring moisture content of the 1+ year-old needles is felt to contribute in a significant way to the probability of crown fire occurrences during the spring fire season in many areas (Fuglem and Murphy 1980; Simard and others 1983; Norum and Miller 1984), including the northern Rocky Mountains (Norum 1975), although other fuel and weather factors are no doubt involved. The reason for this spring decrease in FMC is not entirely a reduction in the amount of water in the needles but also, in part, a corresponding increase in starch content (Little 1970). This is not so much a weather-caused phenomenon as a physiological one; there are, however, field reports which suggest that occasionally severe drought conditions lead to abnormal moisture stress in trees growing on sandy, well-drained sites. The exact timing of the normal "spring dip" varies with elevation and latitude (Philpot 1963; Fuglem and Murphy 1980). Significant differences in the moisture content of coniferous foliage between tree species and needle age do exist. There is substantial evidence to suggest that the annual trend probably does not vary greatly from year to year. The possibilities for obtaining a reasonable FMC value are:

- general rules-of-thumb (typical value(s) for time of year and/or stage of plant growth) in a manner similar to the way in which estimation of moisture content in minor vegetation is handled by Rothermel (1983, p. 13, table II-2);
- on-site, near real-time measurement (Sackett 1980; Norum and Miller 1984);
- rely on published curves (table 2) or data (Brown 1978, p. 28-29) in the literature; or
- conduct independent study for species and locale of interest (Agee and Huff 1988).

Roussopoulos (1978a, 1978b), for instance, simply used a standard FMC value of 100% in his nomogram guide to the prediction of crown fires as "a common midsummer moisture content" in northeastern Minnesota.

Live Crown Base Height (LCBH)

The proportion of live tree crown does of course vary with tree height, stand density, etc. For example, in central British Columbia, Muraro (1971) found that the ratio of LCBH to tree height in lodgepole pine to be about 0.6:1. The distance from the ground surface to the base of the live crowns in a coniferous forest stand could be determined by:

- actual physical measurement;
- field observation ("guess-timate"); and/or
- infer from known relationship (for example, stand height and perhaps some measure of tree density) as illustrated in figure 4.

Examples of the latter method are also given in Anderson (1974), Cole and others (1982), Holdaway (1986), and Ritchie and Hann (1987).

Crown Bulk Density (CBD)

Determination of CBD requires: (1) crown foliage weight vs. diameter-at-breast height (dbh) relationship for the species of interest (Muraro 1971; Anderson 1974; Brown 1978; Roussopoulos 1978b; Freeman and others 1982); (2) number of stems per hectare (or acre) by dbh size class (based on stand exam or cruise data); and (3) the average stand crown length (this could of course be inferred from the mean stand height and mean live crown base height). There are basically two approaches available for determining crown bulk densities:

- calculate from stand inventory data and computer program, such as **HAZARD** (Puckett and others 1979) or related system (Radloff and others 1982) for a specific area.
- derive representative or stylized value(s) for various forest cover type/structure complexes (for example, "mature lodgepole pine") on a stand basis in a manner analogous to the way in which average individual tree crown bulk densities are quoted by Brown (1978, p. 25-28).

Note that bulk density does vary throughout the crown fuel layer as pointed out, for example, by Muraro (1971), Brown (1978) and others. Such a consideration could in fact result in a more refined estimate of the "effective" LCBH (Sando and Wick 1972; Roussopoulos 1978b).

Table 2--List of foliar moisture content studies conducted on conifer tree species in North America to date

No.	Reference(s)	Species[1]	Location
1.	Bunting, Stephen C.; Wright, Henry A.; Wallace, Walter H. 1983. Seasonal variation in the ignition time of redberry juniper. Journal of Range Management. 36(2): 169-171.	RJ	north-central Texas
2.	Chrosciewicz, Z. 1986. Foliar moisture content variations in four coniferous trees of central Alberta. Canadian Journal of Forest Research. 16(1): 157-162.	BS, WS, BF, JP	central Alberta
3.	Fingland, Randy D. 1987. Seasonal foliar moisture trends in Banff National Park. Vancouver, BC: University of British Columbia. 64 p. B.Sc.F. Thesis.	LP, WS	southwestern Alberta
4.	Fuglem, Peter L. 1979. Foliar moisture content of central Alberta conifers and its implication in crown fire occurrence. Edmonton, AB: University of Alberta. 148 p. M.Sc. Thesis. [*see* also Fuglem and Murphy 1980 in REFERENCES].	LP, BS, WS-ES	central Alberta
5.	Cary, Howard L. 1971. Seasonal and diurnal changes in moisture contents and water deficits of Engelmann needles. Botanical Gazette. 132(4): 327-332.	ES	north-central New Mexico
6.	Hough, W.A. 1973. Fuel and weather influences wildfires in sand pine forests. Res. Pap. SE-106. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 11 p.	SP	north-central Florida
7.	Jameson, Donald A. 1966. Diurnal and seasonal fluctuations in moisture content of pinyon and juniper. Res. Note RM-67. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 7 p.	UJ, AJ, OJ, P	central Arizona
8.	Johnson, Von J. 1966. Seasonal fluctuation in moisture content of pine foliage. Res. Note NC-11. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 4 p.	RP, JP	central Minnesota and Michigan
9.	Kiil, A.D. 1968. Changes in the physical characteristics and moisture content of pine and spruce-fir slash during the first five years after logging. Int. Rep. A-14. Edmonton, AB: Canada Department of Forestry and Rural Development, Forestry Branch, Forest Research Laboratory. 40 p.	LP, WS	west-central Alberta
10.	Kozlowski, Theodore T.; Clausen, J. Johanna. 1965. Changes in moisture contents and dry weights of buds and leaves of forest trees. Botanical Cazette. 126(1): 20-26.	WP, RP, BF, EH	northern Wisconsin
11.	Little, C.H.A. 1970. Seasonal changes in carbohydrate and moisture content in needles of balsam fir (Abies balsamea). Canadian Journal of Botany. 48(11): 2021-2028. [*see* also Little 1970 in REFERENCES].	BF	central New Brunswick
12.	Philpot, Charles W. 1963. Vegetation moisture trends in the central Sierra Nevada. Berkeley, CA: University of California. 53 p. M.Sc. Thesis. [*see* also Philpot 1963 in REFERENCES].	PP	central California
13.	Philpot, Charles W.; Mutch, Robert W. 1971. The seasonal trends in moisture content, ether extractives, and energy of ponderosa pine and Douglas-fir needles. Res. Pap. INT-112. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 21 p.	PP, DF	northwestern Montana
14.	Russell, R.N.; Turner, J.A. 1975. Foliar moisture content during bud swelling and needle flush in British Columbia. Bi-monthly Research Notes. Ottawa, ON: Canadian Forestry Service; 31(4): 24-25.	CF, WH, DF, NS	Vancouver Island, British Columbia
15.	Springer, E.A.; Van Wagner, C.E. 1984. The seasonal foliar moisture trend of black spruce at Kapuskasing, Ontario. Canadian Forestry Service Research Notes. 4(3): 39-42.	BS	northeastern Ontario
16.	Van Wagner, C.E. 1967. Seasonal variation in moisture content of eastern Canadian tree foliage and the possible effect on crown fires. Dep. Publ. No. 1204. Ottawa, ON: Canada Department of Forestry and Rural Development, Forestry Branch. 15 p.	WP, RP, JP, BF, WS	eastern Ontario
17.	Van Wagner, C.E. 1974. A spread index for crown fires in spring. Inf. Rep. PS-X-55. Chalk River, ON: Canadian Forestry Service, Petawawa Forest Experiment Station. 12 p.	RP	eastern Ontario

[1]WP = eastern white pine; PP = ponderosa pine; RP = red pine; JP = jack pine; LP = lodgepole pine; SP = sand pine; P = pinyon pine; WS = white spruce; ES = Engelmann spruce; BS = black spruce; NS = Norway spruce; EH = eastern hemlock; WH = western hemlock; BF = balsam fir; CF = grand fir; DF = Douglas- fir; RJ = redberry juniper; UJ = Utah juniper; AJ = alligator juniper; OJ = one-seeded juniper.

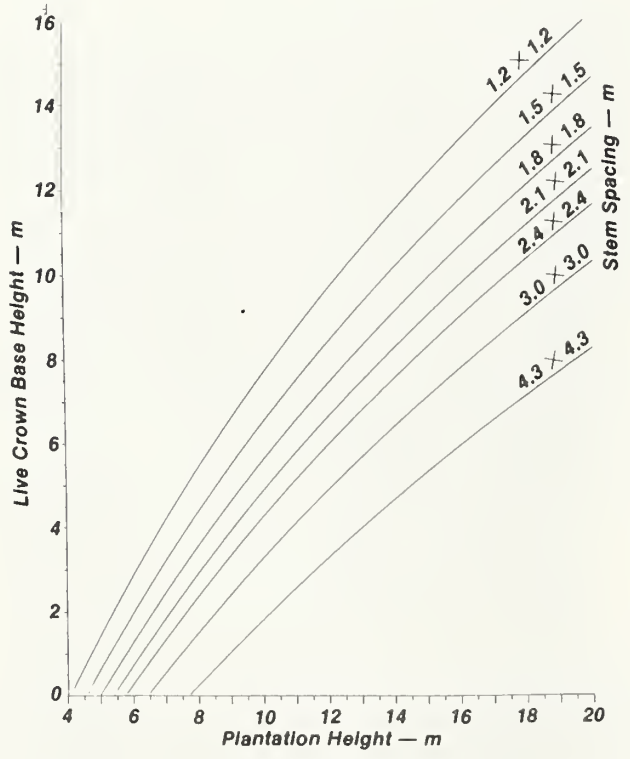

Figure 4--Relation between live crown base height and stand height in unthinned red pine plantations in eastern Ontario according to Stiell (1980).

I. Surface Fire Intensity (I_S) is predicted to be less than 10 kW/m.
   A. A firebrand has caused an ignition to occur ***SELF-EXTINQUISHING FIRE; FAILS TO SPREAD.***
   B. Going fire ***GROUND or SUBSURFACE FIRE.****

II. Surface Fire Intensity (I_S) is predicted to be greater than 10 kW/m but less or nearly equal to the Critical Surface Intensity for Crown Combustion (I_O).
   A. I_S is substantially less than I_O ***SURFACE FIRE.***
   B. I_S is nearly equal to I_O ***Developing PASSIVE CROWN FIRE.***

III. Surface Fire Intensity (I_S) is predicted to be equal to or greater than the Critical Surface Intensity for Crown Combustion (I_O).
   A. Rate of Fire Spread (R) is predicted to be less than or nearly equal to the Critical Minimum Spread Rate for Active Crown Fire (R_O).
      1. R is substantially less than R_O ***PASSIVE CROWN FIRE.***
      2. R is nearly equal to R_O ***Developing ACTIVE CROWN FIRE.***
   B. Rate of Fire Spread (R) is predicted to be equal to or greater than the Critical Minimum Spread Rate for Active Crown Fire (R_O).
      1. Forward heat transfer through the crown fuel layer relies upon surface fire phase ***ACTIVE CROWN FIRE.***
      2. Energy requirements for the continued propagation through the crown fuel layer supplied entirely by the crown fire phase ***INDEPENDENT CROWN FIRE.***

*Assuming there is a forest floor layer of significant depth and dryness.

Figure 5--A dichotomous key to a type of forest fire classification scheme based in part on Van Wagner's (1977) crown fire theory.

CLOSING REMARKS

Van Wagner's (1977) crown fire theory has received a fair amount of exposure in the wildland fire science literature (for example, Chandler and others 1983; Rothermel 1983; Pyne 1984) but implementation has been limited (see, for example, Roussopoulos 1978a, 1978b). His semi-physical model does remain largely untested. There certainly is a very strong need for further basic and applied research on crown fire modelling, especially with respect to spread rate prediction. Nevertheless, Van Wagner's approach, which is based on certain fundamental principles of fire physics, can be immediately applied to the systematic assessment of crown fire hazard (or at least supplement expert opinion) for use, at least on an interim basis, as an aid or tool in fire and fuel management planning today, particularly in even-aged conifer stands (fig. 5). For example, alternate strategies for manipulating the overstory stand structure and composition to limit the possibility and extent of crowning could be simulated (Sando and Wick 1972); this analysis could be coupled with a consideration of an area's "fire behavior climatology" (Salazar and Bradshaw 1986). Application of Van Wagner's model as a field guide and/or computer-assisted program for near real-time prediction of crown fire potential would, however, require some compilation and synthesizing of available information.

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A free-burning active crown fire in the boreal forest region of central Alberta (photo by author).

INTERNATIONAL SYSTEM (SI)-TO-ENGLISH UNIT CONVERSION FACTORS

If the SI units are:	Multiply by:	To obtain:	Inverse Factor
kilograms per cubic metre (kg/m^3)	0.062428	pounds per cubic foot (lb/ft^3)	16.018
kilograms per square metre (kg/m^2)	0.20482	pounds per square foot (lb/ft^2)	4.8824
kilojoules per kilogram (kJ/kg)	0.43021	Btu per pound (Btu/lb)	2.3244
kilowatts per metre (kW/m)	0.28909	Btu per second per foot (Btu/sec/ft)	3.4592
metres (m)	3.2808	feet (ft)	0.3048
metres per minute (m/min)	3.2808	feet per minute (ft/min)	0.3048
metres per minute (m/min)	2.9826	chains per hour (ch/hr)	0.33528

Note: All factors are given to five significant digits. If fewer, the value is exact. To convert English unit values to SI multiply by the inverse factor given in the right-hand column. A "Btu" is a British thermal unit.

APPENDIX: Critical Surface Intensity (I_o) and Flame Length (L_o) for Crown Combustion in Coniferous Forest Stands versus Live Crown Base Height (LCBH) and Foliar Moisture Content (FMC) based on Van Wagner (1977) and Byram (1959). Units: kilowatts per metre (kW/m) and metres (m).

LCBH (m)	FMC (% ODW basis)											
	75	80	85	90	95	100	105	110	115	120	125	130
	I_o (kW/m)											
0.5	42	45	49	52	56	60	64	68	72	76	80	84
1.0	118	128	138	148	159	169	180	191	203	214	226	238
1.5	217	235	253	272	291	311	331	351	372	393	415	437
2.0	335	362	390	419	449	479	510	541	573	606	639	673
2.5	468	506	545	586	630	669	712	756	801	847	893	941
3.0	615	665	717	770	824	880	936	994	1,053	1,113	1,174	1,236
3.5	775	838	903	970	1,038	1,108	1,180	1,253	1,327	1,403	1,480	1,558
4.0	946	1,024	1,104	1,185	1,269	1,354	1,441	1,530	1,621	1,714	1,808	1,904
4.5	1,129	1,222	1,317	1,414	1,514	1,616	1,720	1,826	1,934	2,045	2,157	2,271
5.0	1,323	1,431	1,542	1,656	1,773	1,892	2,014	2,139	2,266	2,395	2,526	2,660
5.5	1,526	1,651	1,780	1,911	2,046	2,183	2,324	2,467	2,614	2,763	2,915	3,069
6.0	1,739	1,881	2,028	2,177	2,331	2,488	2,648	2,811	2,978	3,148	3,321	3,497
6.5	1,961	2,121	2,286	2,455	2,628	2,805	2,986	3,170	3,358	3,550	3,745	3,943
7.0	2,191	2,371	2,555	2,744	2,937	3,135	3,337	3,543	3,753	3,967	4,185	4,407
7.5	2,430	2,629	2,834	3,043	3,258	3,477	3,701	3,929	4,162	4,400	4,641	4,887
8.0	2,677	2,897	3,122	3,352	3,589	3,830	4,077	4,328	4,585	4,847	5,113	5,384
8.5	2,932	3,172	3,419	3,672	3,930	4,195	4,465	4,741	5,022	5,308	5,600	5,897
9.0	3,194	3,456	3,725	4,000	4,282	4,570	4,865	5,165	5,471	5,783	6,101	6,425
9.5	3,464	3,748	4,040	4,338	4,644	4,956	5,276	5,601	5,933	6,272	6,617	6,968
10	3,741	4,048	4,363	4,685	5,015	5,353	5,697	6,049	6,408	6,774	7,146	7,525
11	4,316	4,670	5,033	5,405	5,786	6,175	6,573	6,979	7,393	7,815	8,244	8,681
12	4,918	5,321	5,735	6,159	6,593	7,036	7,490	7,952	8,424	8,904	9,394	9,892
13	5,545	6,000	6,467	6,945	7,434	7,934	8,445	8,966	9,498	10,040	10,592	11,153
14	6,197	6,706	7,227	7,761	8,308	8,867	9,438	10,021	10,615	11,221	11,837	12,465
15	6,873	7,437	8,015	8,607	9,214	9,834	10,467	11,113	11,772	12,444	13,128	13,824

LCBH (m)	FMC (% ODW basis)											
	75	80	85	90	95	100	105	110	115	120	125	130
	L_o (m)											
0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6
1.0	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0
1.5	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.3
2.0	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5
2.5	1.3	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.8
3.0	1.5	1.5	1.6	1.6	1.7	1.8	1.8	1.9	1.9	2.0	2.0	2.0
3.5	1.7	1.7	1.8	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.2	2.3
4.0	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.3	2.3	2.4	2.4	2.5
4.5	2.0	2.0	2.1	2.2	2.2	2.3	2.4	2.5	2.5	2.6	2.6	2.7
5.0	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.6	2.7	2.8	2.8	2.9
5.5	2.3	2.3	2.4	2.5	2.6	2.7	2.7	2.8	2.9	3.0	3.0	3.1
6.0	2.4	2.5	2.6	2.7	2.7	2.8	2.9	3.0	3.1	3.2	3.2	3.3
6.5	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.2	3.3	3.4	3.5
7.0	2.7	2.8	2.9	3.0	3.1	3.1	3.2	3.3	3.4	3.5	3.6	3.7
7.5	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9
8.0	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0
8.5	3.0	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2
9.0	3.2	3.3	3.4	3.5	3.6	3.7	3.8	4.0	4.1	4.2	4.3	4.4
9.5	3.3	3.4	3.5	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5
10	3.4	3.5	3.7	3.8	3.9	4.0	4.1	4.3	4.4	4.5	4.6	4.7
11	3.6	3.8	3.9	4.0	4.2	4.3	4.4	4.5	4.7	4.8	4.9	5.0
12	3.9	4.0	4.2	4.3	4.4	4.6	4.7	4.8	5.0	5.1	5.2	5.3
13	4.1	4.2	4.4	4.5	4.7	4.8	5.0	5.1	5.2	5.4	5.5	5.6
14	4.3	4.5	4.6	4.8	4.9	5.1	5.2	5.4	5.5	5.7	5.8	5.9
15	4.5	4.7	4.8	5.0	5.2	5.3	5.5	5.6	5.8	5.9	6.1	6.2

THE ROLE OF THE PRIVATE FIRE CONSULTANT IN ASSESSING, REDUCING, AND MITIGATING WILDFIRE DANGER TO RURAL HOME SITES

Charles L. Bushey and Everett M. "Sonny" Stiger

ABSTRACT: Fire consultants in the private sector offer homeowners, neighborhoods, community planners and lawyers a diversity of services aimed at reducing wildfire hazard near residential structures and evaluating wildfire damage. The consultant has available a wide range of talents that can assess and reduce the potential for, or appraise and mitigate the damage from wildfires. These services are offered in conjunction with, but do not attempt to replace, those provided by existing fire suppression organizations.

INTRODUCTION

The private fire consultant is an important link in the quest to help homeowners and neighborhoods reduce their potential danger from catastrophic wildfire. Government and volunteer fire organizations have historically been restricted to fire suppression activities (structural and wildfire), public fire education, and internal inspection of buildings for fire hazard/safety and fire code violations. Very few publicly supported fire organizations have actively sought and maintained a role in the planning and implementation of reduced wildfire hazard to homes and neighborhoods. And in many respects, the roles of those fire suppression agencies have been legally restricted so as not to "interfere" with the expressed rights of the private homeowner to live in the surroundings that they enjoy. The fire agencies have had to work through the educational process to try and reach the growing numbers of individuals who build their homes in fire adapted and/or fire prone vegetation types. These public educational programs have had limited success in changing either the behavior or the desires of the home owner. The private fire consultant can help bridge the gap between mass education to a more personal level of homeowner education. The consultant can help the owner implement a fire hazard reduction program around their home or neighborhood.

PROFESSIONALS WITH EXTENSIVE SKILLS

Private fire consultants dealing with the wildland/residential home interface are still a relatively new profession which requires an unusal combination of talents. They must combine the acquired knowledges of fire ecology, wildfire suppression, and prescribed burning talents with the skills of the urban forester, lawn care specialist, community planner, landscape architect, business manager and public relations expert. Most individuals currently entering this field have had previous fire training and experience with either public or volunteer fire organizations.

RANGE OF SERVICES

The services which a private fire consultant can provide cover the entire range of helping the home owner. These duties usually do not include actual fire suppression services for structural or wildfire situations which are better handled by the organizations specifically equipped and trained for that type of job. The consultant however may closely interact with those fire suppression agencies. The services that our corporation provides, and which others may consider following are easily broken down into five general categories which together form a complete package of services to the interested land owner, community planner, or legal expert;

1. WILDFIRE DANGER ASSESSMENTS. A site visitation should be scheduled with the land owner or client to examine the potential wildfire hazard problems of the home or future residential property. It is during this visit that considerable education of the interested client can be accomplished on a one-to-one basis. Fire consultants should be able to provide a detailed description of the site fire ecology and help the client visualize the resultant vegetation (fuel) and wildlife successional changes which have likely occurred since the last fire or other major land management activity.

Poster paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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A fuel load assessment of the property can be made to help illustrate to the client the amount of potential wildfire fuel that exists within the vicinity of their residence or property. Depending on the quality level desired and the final use of the fuel load assessment the fuel evaluation may be completed in an intensive (quantitative fuel inventory), or in a less intensive (photo guide, general NFFL or NFDRS fuel model) manner.

After the fuel load assessment the fire consultant can provide the client with a potential wildfire behavior evaluation and a "Fire Potential Rating" for the site using weather conditions which would represent an average bad day during the wildfire season in the general vicinity. The wildfire behavior evaluation should be site specific for the fuel conditions that surrounds the home. Fire behavior evaluations may be developed for both the untreated fuel conditions and the consultant recommended fuel levels after implementation of a wildfire hazard reduction program. The predicted wildfire behavior calculations will illustrate to the client the amount of heat, flame length, and other fire behavior predictions the site and residents could possibly experience in the event of a wildfire.

The potential fire behavior the specific site could experience then needs to be explained in layman terms to the client. The discussion should include the probable impacts of a wildfire under those conditions to site structures, vegetation, soil, wildlife habitat, and overall site esthetics. The fire consultant should indicate the potential danger from surrounding lands not owned by the individual currently interested in your services. Either the fire consultant or the land owner may approach these neighbors, however best results are usually attained with neighbors talking to neighbors.

2. PLANNING. The consultant should develop for the homeowner, or preferably for a residential subdivision, a detailed series of steps to formulate a time schedule for reducing their wildfire hazard. These steps need to be within the land use goals and constraints of the owner or neighborhood. A time schedule for implementation of each step is essential to continually reenforce, and eventually attain the goal of reduced wildfire hazard. Another reason for the time schedule is that many steps to reduce wildfire hazard may best be accomplished only during favorable weather or a specific phenological period of the year.

The private fire consultant should be available to consult with community planners, local fire departments and residential developers in designing residences and neighborhoods for reduced wildfire hazard. This cooperation is best accomplished long before construction begins. This work should not only emphasize the need to reduce wildfire hazard around the community through fuel manipulation and increased wildfire resistant structures, but also to increase the ability of fire suppression forces to access and defend the neighborhood while area residents are safely being evacuated. The community should develop with the consultant a workable plan ready to implement their fire fighting and emergency forces in the event a worse case scenario should develop. The plan should include cooperation with other structural and wildland fire suppression forces for an organized plan of attack and support. Additional items which community planners may need help with include developing sensible zoning regulations for their rural/wildland interface. Also subdivisions with "Owners Covenants" may need help with their local regulations in dealing with the topic of wildfire hazard reduction.

3. PROTECTION. The complete private fire consulting service should be able to provide professional, insured or bonded services to implement the plan for the reduction in residential wildfire danger which they have developed. This must be accomplished in an esthetically pleasing manner that fulfills the goals of the home owner. These services may include, but not necessarily be limited to:

a) tree and brush thinning and removal,
b) tree pruning,
c) debris and litter removal,
d) prescribed burning,
e) understory seeding and wildlife plantings,
f) the selective application of chemical herbicides or growth retardents.

These various services should be available if desired, to the client on a long-term contractual basis.

4. WILDFIRE DAMAGE APPRAISAL. As long as man and nature interact there will be wildfires which can potentially damage resources considered valuable by man. Fire consultants need to be available to evaluate fire effects as to their potential benefits or harm to both vegetation and wildlife. This skill requires a knowledge of fire ecology and fire behavior frequently not taught to the average forester, range conservationist or wildlife biologist. It may be periodically necessary for the consultant to develop a cost, or other quantitative assessment of changes in important resource values induced by a wildfire.

Alleged changes in resource values induced by wildfire frequently lead to litigation for reimbursement. The private fire consultant should be knowledgeable enough and available to provide "Expert Witness" testimony in legal conflicts concerning fire effects, fire behavior, fire weather, wildfire suppression and prescribed fire planning and activities.

5. WILDFIRE DAMAGE MITIGATION. In conjunction with the services provided for reducing wildfire hazard around homes, the private fire consultant should be able to apply their skills to the development and implemention of ecologically sound range and forest rehabitation programs on wildfire damaged lands.

CONCLUSION

In whole or part, the services which the private fire consultant can offer provides an important source of expertise for the concerned homeowner, homeowner associations, community planners, and legal professionals confronted with a topic (wildfire) they are unfamiliar with. It is our hope that in the future the private fire consultant can point with pride to completed projects that have saved lives and homes from wildfire.

THE WILDLAND-URBAN INTERFACE: WHAT IT IS, WHERE IT IS AND ITS FIRE MANAGEMENT PROBLEMS

James B. Davis

ABSTRACT: Fire managers across the nation are confronting the rapidly developing problem of people moving into wildland areas, increasing what has been termed the wildland-urban interface. To manage more effectively and plan for this situation, fire managers should analyze the problem as three types of interface areas, each with its own unique set of demographic factors, local land use, and fire protection problems.

INTRODUCTION

Almost all persons involved in wildland fire control are familiar with the term "wildland-urban interface." They probably have seen the growing problem in their communities, that is, a dramatic increase during the past 10 to 15 years in the number of people leaving cities and moving into the wildlands (Davis 1986). When we take a close look at where the interface areas are and how they are affected by population trends, we find a very complex situation.

A ranger on a National Forest in Michigan may view the problem as one of balancing the protection of the natural resources with the political expediency of giving equal or better protection to summer and vacation homes for which the USDA Forest Service has no legal responsibility.

A State forester in New Jersey may lose sleep over the suburban sprawl into the fire prone Pine Barrens. In addition, the forester may see the organization growing at a slower rate than the protection problem and feel the organization will soon be at the lower threshold of suppression effectiveness.

A California fire chief may worry about large accumulations of flammable native vegetation, steep slopes, and narrow winding roads well within the boundaries of what most of us would consider a metropolitan area.

Not only are the vegetation and structural "fuel" problems variable and complex in these different interfaces, but the location and movement of people are different from one part of the nation to another, and population trends change rapidly over time (Bogue 1985).

The problem is further complicated by a patchwork of legal and organizational requirements and constraints. For example, some States have specific legal requirements for the protection of structures in the wildland. Others have no legal responsibility and neither train their personnel, nor purchase the specialized equipment needed for structure protection. On the other hand, many agencies with thousands of acres of wildland within their jurisdictions may be unprepared to effectively fight a wildland fire.

This paper shows how demography—the study of the characteristics of human populations including size, growth, density, and distribution—can be a useful tool for analyzing and predicting fire management problems.

WHERE IS THE WILDLAND-URBAN INTERFACE?

The American people, it seems, are as dynamic and shifting as the desert sand. For most of our history as a nation, there has been a flow of people from rural areas into cities (Herbers 1986). Then, during the 1970's, this traditional pattern changed. Americans left the cities in record numbers to live in small towns and rural areas (Kloppenburg 1983). For the first time since the industrial revolution, the population growth rate outside the nation's metropolitan areas was more rapid than within (fig. 1).

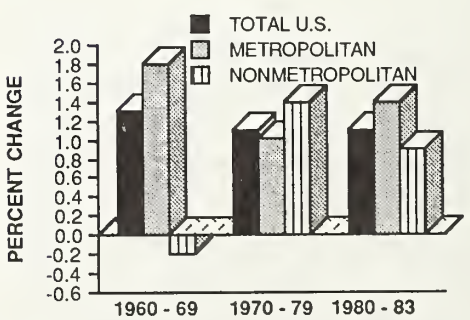

Figure 1—Average annual percent population change by decade (Sternlieb and others 1982).

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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Now there seems to be another change (Bradshaw 1987). Census information from the first half of the 1980's show that urban areas are growing again—but for different reasons. Areas that were once classified as rural are rapidly achieving sufficient population to be reclassified as urban. Typical areas are the Los Angeles Basin and the corridors between Boston and New York, and between New Jersey and Washington D.C. (Engels and Forstall 1985).

If we look at these trends in more detail from a geographic standpoint, we find some important regional relationships. Americans are more dispersed across the country than ever before. A majority of people now live in the the South and the West (Long and DeAre 1983). All but one of the top 10 growth States of the 1970's were west of the Mississippi River. In 19 States the nonmetropolitan areas are still growing at a faster rate than the metropolitan areas. Only in the South is the metropolitan population growing at a much faster rate than is the nonmetropolitan population (table 1).

These changing patterns of population distribution have important implications on how we fight wildland fires today and how we must plan to fight them in the future. To understand the implications of these patterns, we first need to define what is meant by the wildland-urban interface. As implied earlier, the term can mean different things to different people.

Table 1—Percent change in state population growth: 1980-83 (Engels and Forstall 1985)

State	Metropolitan	Nonmetropolitan
Northeast		
Maine	1.4	2.2
New Hampshire	5.2	2.4
Vermont	3.1	2.6
Massachusetts	0.3	5.2
Rhode Island	0.6	3.5
Connecticut	0.9	2.2
New York	0.6	0.7
New Jersey	1.4	——
Pennsylvania	0.2	0.7
Midwest		
Ohio	-0.5	-0.2
Indiana	0.1	-0.8
Illinois	0.8	-0.9
Michigan	-2.5	-0.3
Wisconsin	0.7	1.5
Minnesota	2.6	0.0
Iowa	0.6	-1.0
Missouri	1.1	1.0
North Dakota	3.7	4.6
South Dakota	4.4	0.7
Nebraska	3.5	0.3
Kansas	3.9	1.3
South		
Delaware	1.5	2.9
Maryland	2.1	1.6
Virginia	4.9	1.4
West Virginia	-0.6	1.6
North Carolina	3.8	2.9
South Carolina	4.8	4.1
Georgia	6.2	2.8
Florida	9.4	11.6
Kentucky	0.2	2.5
Tennessee	2.1	1.9
Alabama	2.0	1.1
Mississippi	4.6	1.9
Arkansas	2.1	1.6
Louisiana	5.9	4.7
Oklahoma	10.3	7.4
Texas	11.3	7.3
West		
Montana	4.6	3.6
Idaho	6.5	4.4
Wyoming	7.4	9.9
Colorado	8.5	9.1
New Mexico	6.1	8.5
Arizona	9.6	5.3
Utah	10.1	13.3
Nevada	11.2	11.9
Washington	4.5	2.3
Oregon	1.3	0.6
California	6.2	8.7
Alaska	21.1	17.8
Hawaii	4.8	11.0

WHAT IS THE WILDLAND-URBAN INTERFACE?

The concept of three types of wildland-urban interface areas was first suggested by Charles W. Philpot, Associate Deputy Chief for Research, USDA Forest Service, at a wildland-urban interface meeting in Boston in 1986.

Three general types of interface have been identified (NW/UFPC 1987):

- Classic Interface—where city boundaries and suburbs press against wildland vegetation.
- Mixed Interface—where homes and other structures are intermixed with wildland vegetation.
- Occluded Interface—where islands of wildland vegetation occur inside a metropolitan area.

The Classic Interface

By far the greatest number of people live in (and are moving into) the classic interface (fig. 2). This is the area where homes, especially new subdivisions, press against the wildland area. Frequently, vast, adjacent wooded areas can propagate a massive flame front during a wildfire, and numerous homes are put at risk by a single

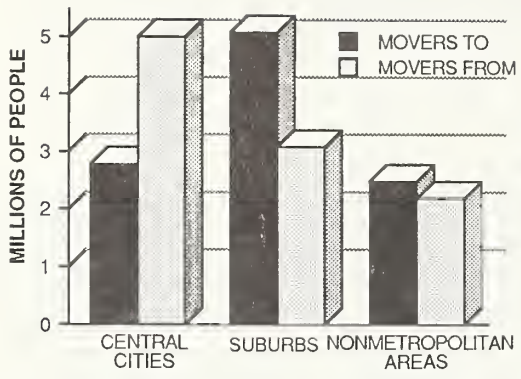

Figure 2—Declining cities and growing suburbs: while the nonmetropolitan areas continue to grow, it is the suburbs that attract most movers. This population growth affects both the classic and occluded interfaces (U.S. Bureau of the Census).

fire sometimes overwhelming fire protection forces and water supplies. The classic interface is also where the greatest structural fire loss occurred in the past and is expected to occur in the future.

Once considered only a southern California problem, now no region of the nation can be expected to escape the problems of the classic interface. In May 1985, 99 homes in Florida's Palm Coast Development were destroyed within a few hours (Abt and others 1987). In 1987, a 900-acre brush fire near Spokane, Washington, destroyed 24 homes and damaged at least 30 others. A New Jersey fire warden predicted that should a fire situation develop similar to the one that occurred in that state in 1963, structural fire loss could amount to 1,500 homes with damage in excess of 100 million dollars (Hughes 1987a, b).

There are at least two reasons why the classic interface is growing so rapidly. The first is that suburbs closest to the central cities are becoming more like the cities themselves with many of the cities' traditional problems (Schapiro 1980). New suburbs are spreading farther from the city center, attracting today's younger families. From a demographic standpoint, the World War II "baby boom" is now today's young-to-middle-aged adults with families. By past standards this is a relatively large and affluent group (Sternlieb and others 1982).

When Americans can afford to move out of the cities or older inner suburbs they frequently do (Newitt 1983). The Washington D.C. area is an example of the relationship between moderate wealth and the demand for space. New subdivisions are spreading across the rural, frequently flammable, Virginia and Maryland countryside—some of them as much as 50 miles or more from downtown Washington D.C.

The second reason for the rapid growth of the classic interface is the development of "super cities." One of the definitions used by the Census Bureau is this one of an urbanized area: a city with a population of 50,000 or more together with all the contiguous built-up land that has a population density of at least 1,000 people per square mile. Much of the increase in "urban" growth during the 1980's has been a rapid change from rural to urban status for many communities. Usually this takes place near—often between—major cities resulting in what has been called the "closing of the megalopolis." Between 1970 and 1980 these areas grew at a rate 10 times that of the inner city (Long and DeAre 1983).

The classic interface is where the built up quality of the subdivision may give a false sense of security. Paved streets, fire hydrants, and green lawns may give the impression that there is no fire threat from nearby wildands. Yet as shown in many fires, embers and burning shakes and shingles flying through the air have ignited roofs a half mile or more from the nearest wildland vegetation.

The Mixed Interface

The mixed interface (sometimes called intermix) usually consists of homes or other buildings scattered throughout the wildland area. Small and occasionally medium sized subdivisions may also be included. Typical are summer homes, recreation homes, ranches, and farms in a wildland setting. Usually these isolated structures are surrounded by large areas of vegetation-covered land. In a fire, the structures are very hard to protect because of the large area that may be burning, but relatively few homes may be at risk.

While these areas are not growing as rapidly in many cases as they once were, the growth rate and infrastructure problems involving schools, roads, water and sewage systems, and fire protection are still formidable. For example, between 1970 and 1978 the five California counties with the highest percentage growth rate in population were in the wildlands of the Sierra Nevada (Irwin 1987a, Sweeney 1979). The population of one of these counties (Alpine) jumped 107 percent between 1970 and 1978. Population growth in the Blue Ridge Mountains of Virginia has been even more rapid. The homes exposed to wildfire loss in portions of the Blue Ridge increased more than 400 percent between 1979 and 1984 (fig. 3).

Frequently the people moving into the mixed interface bring with them a perception of forestry that often clashes with ecological reality. They are much more concerned with their conception of "forest preservation" than with the forester's or fire manager's idea of forest management and conservation. There is often a desire by both home owners and county planning departments to provide open space areas. One California planning commissioner stated, "We regularly review two or three proposals a month that contain either open space or wildlife corridor zoning designations."

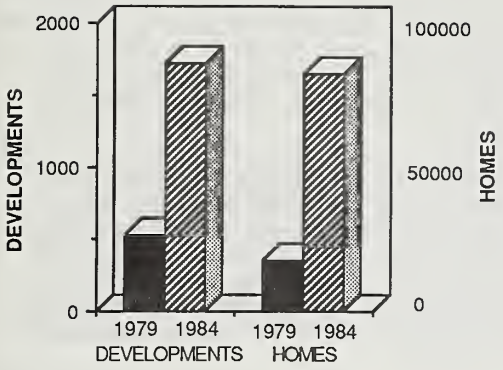

Figure 3—The increase in the number of homes and subdivisions exposed to fire loss in Virginia between 1979 and 1984 (Graff 1986).

Past county (Tuolumne) policy has been to word the conditions of the zoning so that no vegetation will be removed (Irwin 1987b). However, relatively few California counties include fire concerns or fuel management in their open space zoning, allowing fuel corridors to develop that may run through residential developments.

In addition to the newly arriving residents' vulnerability to wildfire, there is the ecological impact on the forest itself (Rice 1987). People try to retain the forested quality of the site not realizing that it is still subject to fire, insects, and disease as before, but is threatened now by the effects of urbanization as well. The root systems of many trees are cut by road construction, compacted, or paved over. Native trees may be adversely affected by watering of lawns and nonnative shrubbery and in some cases so weakened that they are readily attacked by insect pests. Near Lake Arrowhead, in southern California, 50 percent of the pines are damaged by such "people pressure" (Walt 1986). Leaving old declining trees, the weakening or killing of others, and adding houses and other buildings to the list of combustibles in the forest causes a growing load of fuel.

The people moving into the mixed interface are a varied group. In one locality the newcomers were found to include five categories (Herbers 1986, Sweeney 1979):

- Commuters, more and more of whom are willing to travel long distances from a mountain setting to jobs in urban areas.
- The retired, who want to trade-in urban problems such as crime and smog for a remote and more peaceful home in the mountains or foothills.
- Younger dropouts from the urban rat race. Many of these with families want to raise their children in a simpler, less pressured lifestyle, away from the problems of city schools and rush hour traffic jams.
- Older more successful corporate executives who wish to exchange long hours spent in often well-paying jobs for even longer hours spent launching their own small businesses.
- The poor, who may find that it is the only place they can afford to live. In many cases a home (or mobile home) in the wildland is far less expensive than similar accommodations in more developed places.

Many of these newcomers possess at least two characteristics in common: they are very aware of their environment; and they are very much interested in getting involved in what has been called "stewardship of the land." Every Forest Service manager responsible for a forest plan knows well the extent of this wish for involvement and participation.

Complicating the fire problems in the mixed interface is that frequently the only fire protection available is either forestry agencies that are budgeted, equipped, and trained only for wildland firefighting, or poorly staffed and poorly equipped volunteers. Fire managers must make the tough decisions about sacrificing natural resources to protect homes and other structures, usually with personnel and equipment not particularly suitable for the job. This conflict leads to a mismatch between property owner's fire protection expectations and fire agency protection strategies, which frequently leads to lack of trust, and—on occasion—to litigation.

The Occluded Interface

An occluded interface is characterized by isolated (either small or large) areas of wildland within an urban area. An example is an undeveloped or primitive city park surrounded by homes trying to preserve some contact with a natural setting.

The same demographic trends affecting the classic interface also influence this interface. As the megalopolis closes to make a super city, islands of undeveloped land get left behind. In some cases these are specifically set aside as parks. In other cases they may be steep difficult places that are unsuitable as building sites. The occluded interface may even occur in portions of inner cities as parks or as intractable terrain left behind by developers.

Many homes and other buildings may be at risk, but the relatively small wildland areas are not as subject to large scale fire. This does not mean that fires cannot be deadly. In 1985 three home owners died when an 8-acre fire, well within the Los Angeles metropolitan area, swept up a steep slope and overran their homes. Fires in the

occluded interface can be dangerous and difficult to fight because of steep difficult terrain and limitations on suppression methods due to the proximity of structures. The Los Angeles County Griffith Park Fire of 1933--a typical occluded interface fire--was the most tragic in the nation's history from the standpoint of firefighter casualties, with 25 killed and another 128 injured (Wilson 1977).

The Griffith Park Fire is possibly the nation's worst fire of any type--forest or structural--based on total firefighter casualties. More total lives, however, have been lost on several large historical fires. These include the 1871 Peshtigo Fire in Wisconsin where 1,500 people perished, the 1894 Hinkley Fire in Minnesota with 418 fatalities, and the 1881 Michigan Fire in which 169 people died (Davis 1959).

IMPLICATIONS FOR FIRE MANAGEMENT AND RESEARCH

The wildland-urban interface is very complex from the standpoint of fire planning and management. Each type of interface--mixed, classic, and occluded--has its unique demographic characteristics and fire protection problems.

Demographic analysis can help managers to (1) identify each type of interface, (2) identify the occupants of each interface, and (3) track population trends affecting the interfaces.

By examining and understanding how these future population trends will affect fire protection tactics and strategy in each of the interfaces, managers should be able to plan ahead--to be proactive rather than reactive in relations with the public and its leaders in managing the wildland-urban interface fire problem.

A recent survey of California fire managers assessed the research needs of the interface fire problem. The highest priority for research was for an effective method to communicate with the public, and particularly, public policy leaders before there was commitment to a course of land development that might be contrary to good fire protection (Davis 1987).

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APPLICATION OF FIRE DANGER RATING TO THE WILDLAND/URBAN FIRE PROBLEM: A CASE STUDY OF THE NISBET PROVINCIAL FOREST, SASKATCHEWAN

William J. De Groot

ABSTRACT: Fire potential is quantified in terms of fire intensity, rate of fire spread, and fire growth for a wildland/urban interface area in central Saskatchewan based on historical weather records and the Canadian Forest Fire Danger Rating System (CFFDRS). Conditions conducive to fast spreading (>22 m/min), high intensity (>4000 kW/m) fires with rapid growth (>55 ha in one hour) occur on a regular basis during the fire season. The CFFDRS can indirectly be used to communicate this wildland/urban fire problem to the public.

INTRODUCTION

The problem of fire in the wildland/urban interface has become increasingly more apparent through the many recent workshops, symposiums and conferences dealing with this topic, as well as through home and life-threatening occurrences. Quantification of this fire problem through research and technology transfer has been described as part of the solution (Gale and Cortner 1987; Laughlin and Page 1987). Although the exact role that the research community will play has not been specifically identified, there undoubtedly are opportunities for application of current available research through the technology transfer process.

Research into fire danger rating and fire behavior has a long history (Brown and Davis 1973) and products from this research can be used to quantify the wildland fire aspects of the wildland/urban fire problem. This includes rate of fire spread, area burned, fireline intensity, spotting, and crowning potential. These forest fire management terms follow those defined by Merrill and Alexander (1987). For those concerned about protecting people and homes from wildfire, important information would include fire intensity, rate of fire spread and area burned. This paper deals solely with quantifying fire potential in these terms. This type of fire behavior information can be used to develop a means of communicating the wildland/urban fire problem to the general public. Using the wildland/urban area of the Nisbet Provincial Forest as an example, fire potential (measured in terms of rate of fire spread, fire intensity and area burned) was quantified using the Canadian Forest Fire Danger Rating System (CFFDRS) (Canadian Forestry Service, 1987).

THE WILDLAND/URBAN FIRE PROBLEM

The Nisbet Provincial Forest is located in central Saskatchewan, just north of Prince Albert (fig. 1). Mean daily temperatures in this area during January and July are -21.5°C (-6.7°F) and 17.4°C (63.3°F). The mean first snow-free and snow-cover dates are April 22 and October 30. Mean annual precipitation is 40.1 cm (15.8 in.), including 125.0 cm (49.2 in.) of snowfall. The critical area of the Forest (fig. 2) is 26 366 ha (65 153 ac) and has a residential population of over 1 500 either within, or directly adjacent to, its boundaries (Saskatchewan Parks and Renewable Resources 1984). Commercial, institutional and industrial values are also prevalent in the Forest.

Figure 1--Geographical location of the Nisbet Provincial Forest (arrow).

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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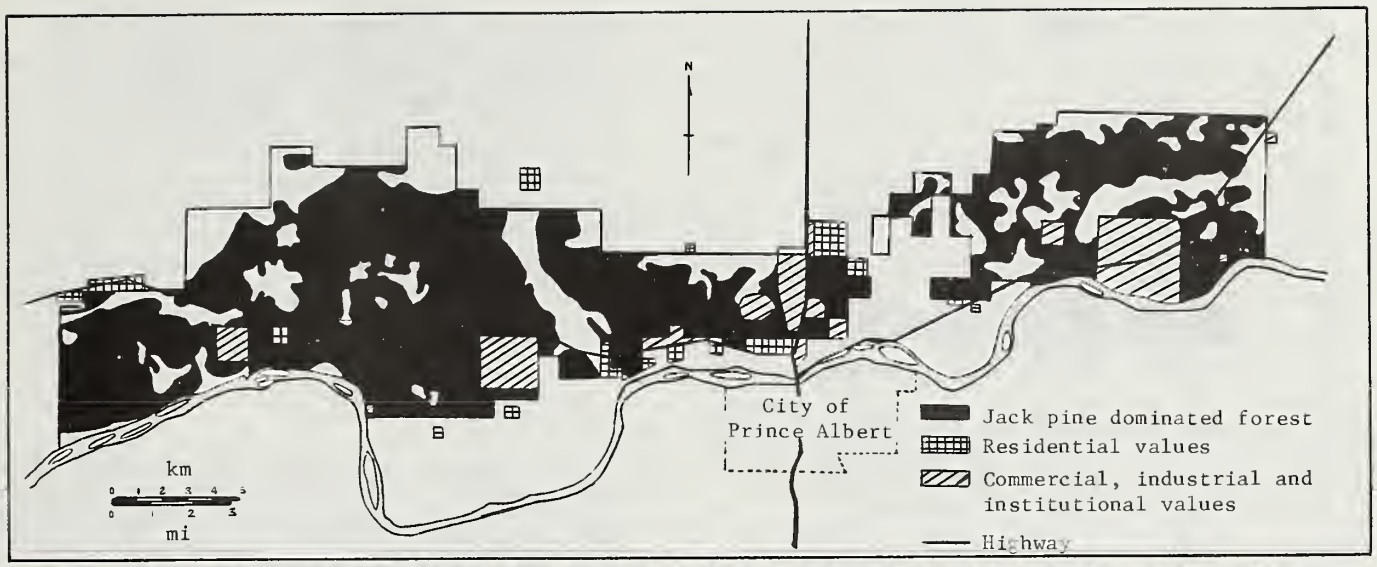

Figure 2--Critical areas within the Nisbet Provincial Forest (after Saskatchewan Parks and Renewable Resources 1984).

The Nisbet Forest is a high-use recreational area, primarily because of the proximity to the City of Prince Albert. Ninety-nine percent of all fires are man-caused, usually the result of abandoned campfires. In 1987, 95 fires required suppression action in the Forest.

Although the Nisbet Forest is located in the mixedwood section of the southern boreal ecoregion (Kabzems and others 1986), jack pine (Pinus banksiana Lamb.) dominates the generally moisture deficient sandy soils of the area. Much of the Forest is heavily infected with dwarf mistletoe (Arceuthobium americanum Nutt. ex Engelm.). The understory is typically reindeer moss (Cladonia sp.), bearberry (Arctostaphylos uva-ursi (L.) Spreng.), dry ground cranberry (Vaccinium vitis-idaea L. var. minus Lodd.), and feather moss (Pleurozium schreberi (BSG.) Mitt.). The topography varies from gently undulating to strongly rolling.

The combination of significant values-at-risk, extensive recreational use with resulting high fire incidence, and the presence of a hazardous fuel type on droughty sites creates a potentially serious fire problem in this wildland/urban interface area.

ANALYZING THE HISTORICAL FIRE POTENTIAL

The only additional element needed to create a dangerous wildfire situation in the Nisbet Forest is the appropriate fire weather. The Canadian Forest Fire Weather Index (FWI) System (Canadian Forestry Service 1984; Van Wagner 1987) is a sub-system of the CFFDRS, and uses consecutive daily noon weather observations to gauge the relative fire potential in a standard fuel type on level terrain. Harrington and others (1983) calculated the component values of the FWI System using meteorological data supplied by the Atmospheric Environment Service of Environment Canada for the period 1953-80. Summaries for the 28 years of FWI System values for the Prince Albert airport meteorological station (Harrington and others 1983) were then applied to the Canadian Forest Fire Behavior Prediction (FBP) System (Alexander and others 1984), another sub-system of the CFFDRS, to quantify frontal fire intensity (Alexander 1982) and rate of fire spread potential on a historical basis.

The fire intensity levels shown in figure 3 follow those designated on the intensity class chart presented in Alexander and De Groot (1988) with low as Class 1, moderate as Class 2, etc. The units of measure are kilowatts per metre (kW/m); the english equivalent is Btu's per second per foot (Btu/(s.ft) [1 kW/m = .29 Btu/(s.ft)]. The intensity class levels for the chart were based primarily on fire suppression capabilities as determined by the expected fire behavior. The rate of fire spread levels used in figure 4 follow

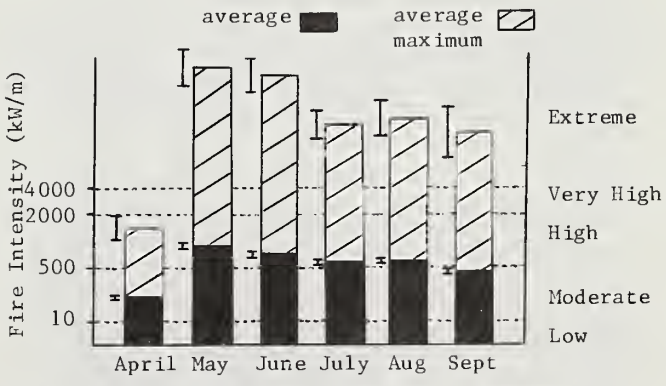

Figure 3--Historical frontal fire intensity potential in the Nisbet Provincial Forest based on level terrain, a mature jack pine fuel type, and fire weather data for 1953-80 (±1 standard error indicated by error bars on the left).

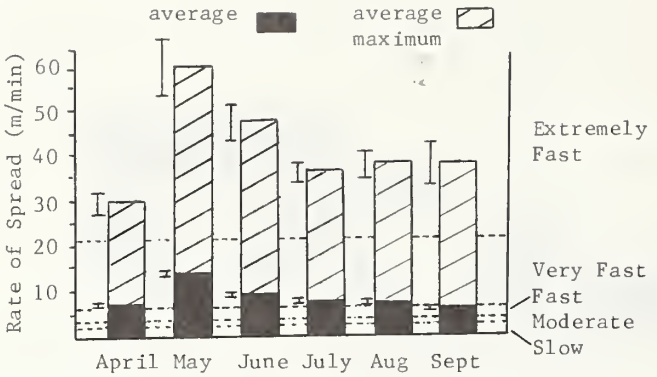

Figure 4--Historical rate of fire spread potential in the Nisbet Provincial Forest based on level terrain, an immature jack pine fuel type, and fire weather data for 1953-80 (±1 standard error indicated by error bars on the left).

those of the province of British Columbia (British Columbia Ministry of Forests 1983), with the exception of 22 m/min (72 ft/min) being used to separate Very Fast from Extremely Fast. For both figures 3 and 4, the average bar reflects a 28-year average of every day in that month; the average maximum bar reflects a 28-year average of only the single most severe burning day in that month.

THE NISBET WILDFIRE SCENARIO

In order to quantify potential area burned, several assumptions had to be made in the construction of the wildfire scenario.

Good ground access and fire detection capabilities in the Forest make it reasonable to assume that initial attack forces should be at the fire site no later than one hour after it starts. This state of readiness would certainly hold true on severe burning days, provided that a multiple-fire situation did not occur. For the purposes of the present exercise, each fire was allowed to burn freely for a one-hour period.

To get a reasonably accurate estimate of the probable area that would be burned over, a worst-case situation was created. Each one-hour fire growth projection was started during the peak burning period in mid-afternoon on the most severe fire weather day in each month of the normal fire season.

Two problems which needed to be addressed in the development of this scenario were in establishing the location and number of fire starts. Knowing fire locations would allow accurate selection of the fuel type and slope. As well, the area burned could be mapped overtop of values-at-risk using a simple elliptical fire growth pattern (Alexander 1985) as in the FBP System (Lawson and others 1985; De Groot and Alexander 1986). However, to simplify this scenario it was decided that selecting fire locations would not be done. Immature jack pine on level terrain was used for all fires since it is the most hazardous and predominant fuel type in this area.

Creating multiple-fire situations would also overcomplicate the scenario. It was decided that one fire per month occurring on the most severe fire weather day in each month would be sufficient to indicate the potential for area burned. For the period 1978-82, noon weather observations from the Prince Albert weather station were used to calculate the FWI System component values (Van Wagner and Picket 1985). The simple elliptical fire growth model incorporated in the FBP System was then used to calculate area burned (McAlpine 1987). Table 1 summarizes the results of the one-hour free-burning fire growth simulations.

DISCUSSION

The historical fire potential of the Nisbet Forest indicates that it is an area of high fire danger. Historically, the average fireline intensity (from May to September, 1953-80) is classed as 'High' (fig. 3). Fires in this category are often surface fires of moderate vigor requiring heavy ground equipment and air support for control (Alexander and De Groot 1988). Also, at least one day of each month during the same period was classed as an 'Extreme' fire intensity day (fig. 3). Fires starting under such conditions become active crown fires and often exhibit 'blowup' or 'conflagration' type behavior which cannot be controlled. It should be noted that figure 3 was based on the mature jack pine fuel type because similar information is not yet available for immature jack pine. However, it is expected that immature pine would exhibit greater frontal fire intensities under similar conditions.

Figure 4 shows that the average forward rate of fire spread during the fire season (by month for April to September) is Very Fast (6-22 m/min; 20-72 ft/min). As well, at least one day of each month during the same period was classed as a day of Extremely Fast (>22 m/min.; >72 ft./min.) forward spread rates.

The results in table 1 show that there is potential for serious fires in the Nisbet Forest. Severe burning conditions are reflected in the components of the FWI System. Using the Initial Spread Index (ISI) to calculate probable area burned, it is apparent that most summer months have conditions which are conducive to a fire becoming 100-200 ha (250-500 ac) in size within an hour of ignition. Realistically, most of the simulated fires in table 1 would be uncontrollable if allowed to attain the one-hour size. The possibility of multiple fires should also be considered. Any fires that might still be burning during a period of critical weather could further complicate control problems. This could translate to over-extended suppression resources and a longer free-burning period for new fires. The point to realize is that this wildfire scenario is still a fairly conservative estimate of potential fire growth.

Table 1--Noon weather observations and potential area burned in the Nisbet Provincial Forest associated with the most severe fire weather day of each month during the 5-year period 1978-82. Fire size calculations are based on a single ignition burning uncontrolled for a one-hour period at midafternoon in an immature jack pine fuel type on level terrain

Date			Temperature		Relative	Wind Speed		Selected FWI System Components[1]			Area Burned	
M	D	Y	°C	(°F)	Humidity (%)	km/h	(mph)	FFMC	ISI	FWI	hectares	(acres)
5	14	78	20	68	26	26	16	91.5	19.6	25.9	141	348
6	3		24	75	36	28	17	90.2	18.2	31.2	105	260
7	25		25	77	34	33	20	90.8	25.3	47.8	162	400
8	7		22	72	41	46	29	89.3	39.3	49.5	198	489
5	27	79	26	79	31	30	19	91.8	25.1	31.0	186	460
6	18		23	73	35	30	19	90.5	20.8	25.5	128	316
7	20		31	88	40	19	12	90.8	12.5	18.4	75	185
8	1		25	77	38	33	20	90.1	22.8	37.8	133	329
5	20	80	24	75	22	37	23	93.4	45.1	88.4	356	880
6	12		20	68	42	35	22	90.4	26.5	50.4	160	395
7	27		23	73	21	19	12	92.5	15.9	32.9	136	336
8	22		17	63	45	37	23	87.7	19.8	34.2	82	203
5	15	81	5	41	41	41	26	89.0	29.5	47.6	147	363
6	26		27	81	32	33	20	91.8	29.1	56.4	212	524
7	9		22	72	32	28	17	88.3	13.8	30.1	55	136
8	28		28	82	37	26	16	91.0	18.3	38.1	121	299
5	25	82	26	79	29	35	22	92.2	34.3	43.2	253	625
6	30		21	70	37	31	19	91.4	25.0	50.1	174	430
7	1		23	73	60	31	19	88.1	15.6	37.7	63	156
8	7		19	66	55	41	26	85.7	18.3	20.3	57	141

[1]FFMC, Fine Fuel Moisture Code; a numerical rating of the moisture content of litter and other cured fine fuels. ISI, Initial Spread Index; a numerical rating of the expected rate of fire spread (combines FFMC and wind). FWI, Fire Weather Index; a numerical rating of fire intensity (combines ISI and a fuel availability index) that is used as a general index of fire danger.

CONCLUDING REMARKS

In the Nisbet wildland/urban interface area which has 1 500 permanent residents and a heavy recreational demand, a rapidly-spreading, high-intensity fire could be disastrous. An analysis of historical fire potential and the previous wildfire scenario demonstrated that these types of forest fires are distinctly possible.

Often a crisis is required for the general public to appreciate the seriousness of a situation. Perhaps the threat of catastrophic fire in the wildland/urban setting can be better communicated to landowners and recreationists by using fire danger rating to quantify potential fire damage and impacts.

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BE YOUR OWN BEST FIREMAN--DON'T DEPEND ON THE GOVERNMENT

Trooper Tom Lugtenaar

PROTECTING YOUR HOME

Do not depend exclusively on governments to protect your home. Understand that there are always breakdowns in communication and honest learning mistakes--unintentional, but constant. Knowledge is the most important factor in protecting people and homes from wildfire. A new book "Wildfire Across North America: From Dragon Slayers...What To Do About It And How To Save Yourself," is a comprehensive book for inexperienced homeowners, as well as for the professional firefighter.

In this book, a basic wildfire education begins with the use of baby dragons to illustrate and form a foundation. It gives a balanced look at the three fire ecosystems in North America. East, West, and Northern areas are explored in regard to conditions, seasons, traditional tools, and tactics.

Professional wildland firefighters will find concepts that differ from one region to another. This book lays the foundation for all firefighters to be more effective and safe everywhere. Emergency procedures in one area of North America may well differ from another area, so in this age of the Incident Command System (ICS), it is more important than ever to have a broad understanding of the diverse fire setting that is North America.

Fire Management Plans are explored, as is domesticating the wild dragon of the forest in order to use it to burn brush and even to do prescribed burns.

Following knowledge are the needs of the homeowner in terms of tools. Rural homeowners have a home situated in forested lands that they own and have direct control over. A "how-to" Fire Management Plan is a must. A simple step by step implementation of wise forestry practices such as thinning, pruning, fire trails, access roads, and establishment of shaded fuel breaks will ensure more productive forest lands, and secure them from wildfire. At least give a fighting chance to employing natural barriers to exploit the dragon's weaknesses and vulnerabilities, and ambush it long before it gets to your home.

Rural homeowners need:

1. Knowledge, such as from the book "Wildfire Across North America" and from contacts with State and Federal authorities;
2. A small pump such as the Shindaiwa GP-25, 300 feet of one inch fire hose, 10 feet of one inch suction hose, various fittings, and an aerating foam nozzle to make more efficient use of water;
3. Correct hand tools for your fire ecosystem including two fire rakes in the east or two pulaskis in the west or north, a five gallon backpack water pump set up to produce foam, and one drip torch;
4. Five gallons of foam concentrate; and
5. A 100 gallon water storage tank to store along with small pump and hand tools in a mini-fire truck.

Urban homeowners have a home in a subdivision where neighbors use lots of vegetation for privacy and beauty. Here homeowners do not own very much land, usually just a small lot. Hence, they have no direct control over adjacent lands. Mid- to southern California, or eastern pitch pine and jack pine, and even hardwood forests with wildfire histories are good examples, but even areas that don't commonly have wildfire histories can, during uncommon droughts, become danger areas for large fires capable to sweeping through subdivisions and neighborhoods.

Urban homeowners need:

1. Knowledge, such as from the book "Wildfire Across North America" and contacts with State and Federal fire authorities;
2. A larger, stronger pump and large storage of water to be able to completely encase the home in foam quickly. An Acme "Drop" Pump, 10 feet of two inch suction home, 50 feet of 1½ inch fire hose, 200 feet of one inch fire hose, various branch and reducer fittings, two foam nozzles, suction hoses and needle valves and fittings;
3. Large water storage tank such as a swimming pool, hot tub, or under ground water storage tank;
4. Five gallons of foam concentrate; and
5. One drip torch.

It is <u>imperative</u> to have an independent source of power and water, not city water, not an electric

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Poster Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Trooper Tom Lugtenaar is Proprietor, Trooper Tom's Fire Protection Co., P.O. Box 44, Manzanita, OR 97130.

pump. Power and water often go out during fires in times of great need.

Additional information regarding the book and tools is available from the author.

COMPARING PUMPS AND MISSIONS

The Shindaiwa GP-25 pump has a 2 cycle engine, 1.8 horsepower, weighs 12.8 pounds. It pumps 36 gallons of water per minute and produces enough pressure to make good foam. This pump is so light, handy and durable that it is ideal for the rural homeowner.

This pump is also ideal for State and Federal fire control work. Normal pumps on fire trucks, and even the standard M-26 and Mark III pumps, are not mobile enough and pump too many gallons per minute to exploit small springs, brooks or potholes. Also, their costs are prohibitive for the average homeowner.

Many times water is near wildfires, but truck access is impossible due to steep terrain or vegetation blocking routes to the water source. With the GP-25, you can quickly take the pump with you on foot and exploit waters previously unreachable with a pumper on wheels.

Justification for Government purchases outside GSA for Forest Service use can be made on standard requisitions by stating the above reasons as to why this pump should be secured and carried as a back-up on standard fire trucks. It surely gives fire crews a completely new and needed capability.

The Shindaiwa GP-45 is a larger, two-stroke pump. It produces more volume in terms of gallons per minute, but does not seem to produce as much pressure as the smaller and cheaper GP-25. Also, it has 1½ inch suction and hose ports, all making it heavier, more gangly, and less handy. Through extensive testing, the GP-25 has proven superior in all respects over the GP-45. In Alaska, the GP-25 has been used to chase extensive large, hot tundra and taiga fires by simply exploiting the many potholes of water, knocking down several hundred feet of flame, picking up hose and pump, and running ahead to exploit another pothole and so on. The GP-25 is a tremendous boon to wildfire control.

The Acme "Drop" pump has a 2 cycle engine, 3 horsepower, and weighs 31 pounds. It pumps 100 gallons of water per minute, and produces enough pressure to make good foam. This pump is not as light and handy as the GP-25 Shindaiwa. The 2 inch suction and hose ports makes it more gangly to handle for running around with, but it does produce a lot more foam faster than the GP-25, which makes it much better suited for encasing a home and surrounding trees and shrubs in foam. Thus, it is the pump of choice for the urban homeowner, and still at a very low price.

THE CASE FOR FOAM

Foam, like water, cools the fire, but it also smothers it and keeps oxygen away. So, from the start it already has the one-two punch that water alone does not have.

The next great advantage is that it expands water and makes it go much, much further. It also has the timed release advantage over water. In other words, foam continues to release more penetrating and more efficient water as the bubbles in the foam continue to break down and release their hammering and continual effect on the heat smoldering under the foam blanket, for a long, long time. Water alone would have dispersed and vaporized, allowing uncooled embers to rekindle. The foam blanket itself causes vapor and humidity to be trapped and forced down into the smoldering mass, which in turn cools it more and more. Because of the soap in the water released from the foam, this water is wetter than regular water and breaks through surface tension and simply penetrates more efficiently than normal water.

It is biodegradable and environmentally safe. Basically, it is a super soap and homeowners are advised to wash their car with the pump and foam system to ensure adequate practice and confidence in employing the system for eventual use against a wildfire or structure fire. A good quality dishwashing soap like Joy or Dawn work almost as well as the new foam concentrates. The foam chemicals are better, as that is what they were developed for, but in a pinch, the dish soaps will produce a foam.

DEVELOPING CUSTOMIZED WILDLAND FIRE TRAINING TO PROTECT PEOPLE, HOMES AND OTHER RESOURCES AT THE URBAN/WILDLAND INTERFACE

James L. Murphy and Frank T. Cole

INTRODUCTION

Federal, state and local resource management agencies have special and unique responsibilities at the urban/rural/wildland interface. Prescribed fire and fire suppression training may be one of these responsibilities.

Agencies may use prescribed fire as a management tool and escape fires do occur. Sound training programs in fundamentally important subjects such as fire behavior are a must, both for agency personnel and cooperators, public and private. The job of developing and conducting fire for interface cooperators frequently falls to the wildland resource management agency and this is true of many National Wildlife Refuges in the U.S. Fish and Wildlife Service.

Escaped prescribed fires over the last 10 years in the National Refuge System have resulted in fatalities and the loss of millions of dollars of natural and man-made resources. One escaped prescribed fire on a North Carolina Refuge that burned onto private land resulted in a series of lawsuits costing the Government nearly $3.5 million. The Service recognized the critical need for the development and presentation of training programs designed to help fire practitioner personnel understand and apply the principles and processes of wildland fire behavior, fire suppression, and fire safety. Refuges and cooperators could not always afford both the expense and the time off the job necessary for refuge personnel to complete the extensive series of suppression courses (S-courses) and other multi-agency training available in some areas each year. Travel restrictions were increasing and training budgets were decreasing. The Service had very few people qualified to teach fire courses. Because of the unique nature of refuge locations, management objectives and problems, training had to be tailored to meet specific U.S. Fish and Wildlife Service needs. A customized basic wildland fire behavior, fire suppression, and prescribed burning training program was developed by the Service and applied in six Service Regions across the United States.

Poster paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

James L. Murphy is President, Fire Science Systems Corporation, Boise, ID.

Frank T. Cole is Fire Management Coordinator, U.S. Fish and Wildlife Service, Boise Interagency Fire Center, Boise, ID.

TRAINING PROGRAM DEVELOPMENT BY CONTRACT

In 1984, the Service contracted the development and conduct of the first series of courses to Fire Science Systems Corporation (FSS) of California and Boise, Idaho. The FSS team responsible for the training development consisted of wildland fire specialists, a wildlife biologist and training specialists.

JOB AND TASK INVENTORY AND ANALYSIS

FSS Corporation specialists conducted an in-depth analysis of jobs and component tasks of those jobs, which made up or should have made up, the Fire Management Function of the U.S. Fish and Wildlife Service.

The inventory and analysis of jobs covered those performed by personnel permanently or only occasionally assigned to fire management jobs on Refuges within the National Refuge System.

The Job and Task Inventory and Analysis defined 19 discrete job requirements making up the Fire Management Function.

Each job was then broken down by:

1. Tasks making up that job.
2. Steps necessary to carry out and complete the tasks.
3. Standards for completing the task.
4. Conditions under which the jobs and task were to be performed.

The primary purpose of the job and task analysis was:

1. To identify the skills/knowledge requirements necessary to safely and effectively carry out jobs and tasks.
2. To define the training requirements of Refuge System personnel to perform effectively and safely their job assignments.

The Job and Task Inventory and Analysis served other purposes also: for example, aids to

developing a Refuge fire management organization, job descriptions, performance evaluations, and special training and job requirements necessary to deal safely and effectively with the unique cooperative and fire problem at the urban/rural/wildland interface.

The Job and Task Inventory and Analysis indicated the priority needs for training existed at three levels:

Level I	Basic Prescribed Fire, Firefighting, and Fire Safety Training.
Level II	Fire Supervisory ("Overhead") training.
Level III	Fire Management Specialist training.

The development of "Level I Training," a course titled "Basic Fire Management" was the principle goal of the contract and project.

SERVICE STEERING COMMITTEE

A Steering Committee representing the Service at the Washington Office, Regional Office, and Refuge level, and the Service Fire Management Staff at the Boise Interagency Fire Center was chartered. The Committee guided the development of the Job and Task Analysis and the Basic Fire Management Training Program.

THE DESIGN OF BASIC FIRE MANAGEMENT TRAINING

Basic Fire Management was developed to meet a need for basic instruction in:

- Wildland Fire Behavior
- Planning and application of prescribed fire
- Basic initial attack fire suppression principles, strategies and tactics
- Fire safety
- Team participation and operation
- Smoke management principles and techniques

Basic Fire Management was aimed at personnel with little previous training who had some responsibilities for prescribed burning and for initial attack fire suppression.

The basic rationale underlying training requirements as defined by the Job and Task Inventory and Analysis and Refuge personnel is shown sequentially in Figure 1.

The structure of Basic Fire Management training is show in Figure 2.

A series of subjects were identified which were basic and prerequisite to prescribed burning and fire suppression, for example, fire behavior, and lesson plans for these subjects related to both specialty areas.

Another series of subjects were identified which had post-burn application to both specialty areas, for example, mop-up and patrol, and lesson plans relating to both areas were developed.

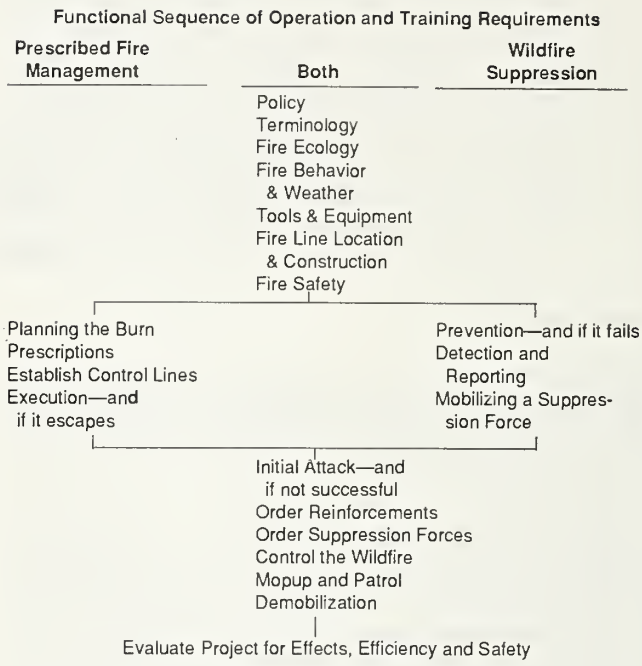

Figure 1--Relationship of prescribed fire and wildfire.

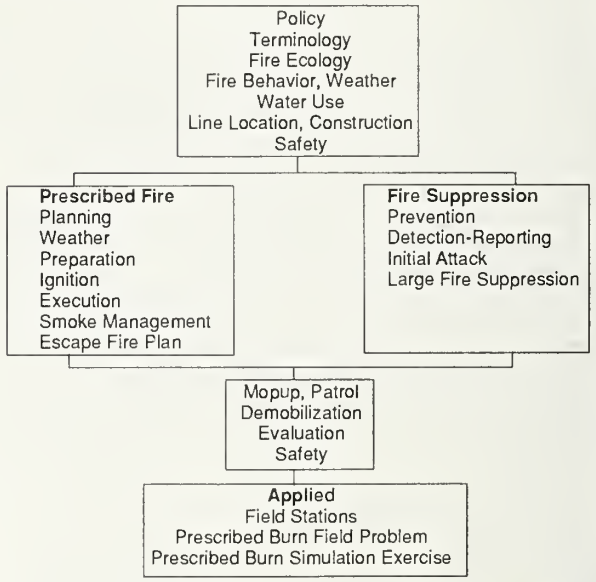

Figure 2--The Structure of Basic Fire Management Training.

The sequential flow of training emphasis is shown in Figure 3. In order to minimize time away from the job as well as travel and other costs, some 25-30 hours of prerequisite subjects were completed (with testing) at the student's home location. Prework assignments also served to bring students to a common level of technical knowledge and understanding.

An important segment of the 36 hour classroom session was the field follow-through. Students organized by teams were given hands-on instruction

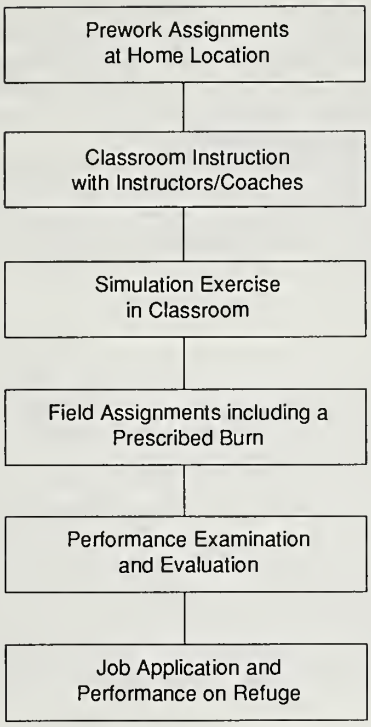

Figure 3--Sequential flow of training and applications.

and practice in tool and equipment use and safety, weather and fire behavior measurements, fire safety including use of the fire shelter, helicopter safety, pumps and water delivery systems. Each student team also planned, prepared for, and carried out an actual prescribed burn and their performance was evaluated by the course instructors acting as coach/evaluator.

Training materials prepared for Basic Fire Management training included:

- Reference texts for all subjects
- Lesson plans for all subjects
- Prework unit
- Visual aids including .35 mm slides
- Student notebooks
- Instructor notebooks
- "How-to-do-it" handouts

SYNERGETIC EDUCATION

To make possible the equivalent of 160 hours of training in just 36 hours in the classroom, Fire Science Systems Corporation has developed and copyrighted Synergetic Education, a system of principles, methods and techniques tailored to specific training courses to enhance the learning process and to make learning more fun and satisfying for the student. Some of the Synergetic Education processes applied to Basic Fire Management were:

1. Specially tailored prework assignments and examinations done at student's home refuge.
2. "Hands-on" class and field exercises including a simulated and live prescribed burn.
3. Student teams with team leaders.
4. The Organization of course cadre as team coaches.
5. Dynamic team-cadre feedback processes applied several times a day for course quality and learning experience corrections.
6. Tutoring and evening sessions.
7. FWS instructor training and development.

UNIQUE FEATURES OF THE SERVICE TRAINING PROGRAM

1. For the first time, the Service has developed an educational program combining prescribed fire with initial attack fire suppression, based on fire behavior principles all integrated with policy, safety, and management/supervisory principles and practices.
2. This adult education program was:
   a. Non-traditional. The Service developed the program to meet its unique management and safety requirements. "Canned" traditional training courses were not used.
   b. On-the-job performance oriented: focused on safer and better jobs.
   c. Success oriented, building in fail-safe operational and safety principles and techniques related to Refuge conditions.
3. Students completed the equivalent of 160 hours of training in just 36 hours of formal classroom work off the job through:
   a. At-home study assignments.
   b. Use of teams, team leaders and coaches.
   c. Classroom work directly combined with field application.
   d. Live training burns in the field as part of the training.
   e. An interactive prescribed burning and initial attack simulation problem.
   f. Special evening team assignments.
4. The Fire Education Program was especially appealing to Interface Cooperators because it was basic, required minimal time in formal classroom work, and emphasized cooperative principles and action.
5. Educated nearly 250 Refuge employees in six Regions and cooperators in fire behavior, suppression, prescribed burning and fire safety in less that 1½ years.

The Service's Basic Fire Management program exceeds the requirements of the required courses for a National Interagency Firefighter:

   a. S-110, S-130 Basic Firefighter.
   b. S-190, Fire Behavior.

Under traditional training programs each student would be required to attend all or major portions of 16 different Interagency "S" Courses to receive the equivalent training and, by necessity, the training would be spread over 3-5 years.

6. Each student was asked to evaluate the program. Ninety-seven percent of all students completing the training said:

a. "Objectives were met," "quite to extremely well."
b. They would recommend the course to others.
c. The course "Fits their needs; practical, usable on the job."

7. Thirteen Fire Management Specialists were trained as Instructors and Coaches and became the "Cadre" to carry on the program and to further refine and adapt it.

8. Team operation and supervisory/managerial skills were taught to students. Refuge personnel learned the importance of team decision-making in fire operations, and that a qualified maintenance worker on a Refuge could be an Incident Commander, supervising a Refuge Manager.

9. Safety awareness and how to apply safety principles on the job has resulted in few minor injuries and no serious injuries or fatalities during burn or fire suppression assignments since the program began in 1985.

CONFLAGRATION PREVENTION SYSTEMS AT THE URBAN WILDLAND INTERFACE:

HIGH RISK FORECASTING AND TOTAL MOBILITY

James L. Murphy and Troy Kurth

ASTRACT: This paper described a first-time Forest Service Regional conflagration fire prevention plan put into action in southern California. Ninety-eight prevention specialists from the Forest Service North Zone and the Pacific Northwest Region along with Bureau of Land Management personnel were organized into twelve task force teams and moved to southern California. A fire occurrence forecasting center was set up at the Riverside Fire Laboratory. Special computer programs produced occurrence forecasts, by cause, for each Ranger District on each of the four National Forests.

The conflagration potential is 200 percent above average!

This was the situation on the four southern California National Forests in September 1979 when the first ever conflagration prevention plan was implemented. Saturation prevention action was taken as the fire danger worsened to prevent conflagration potential wildfires from starting.

Conflagrations or large disaster fires are a primary concern of wildland firefighting organizations everywhere.

Suppression costs on wildland fires in California, for example, are frequently in excess of $150,000 for a 300-acre fire and can exceed $2.5 million for a 10,000-acre fire. Conflagration fires occur all too frequently in high value watershed and areas of urban development where losses of $3,500 per acre are not uncommon.

Conflagration fires in southern California most often occur during conditions that are predictable such as low fuel moisture and high velocity dry winds. These conditions are associated with well understood weather and other physical phenomena. This same predictability is true for the Intermountain West.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

James L. Murphy is President, Fire Science Systems Corporation, Benicia, California. Troy Kurth is Forester, Aviation and Fire Management, USDA Forest Service, Missoula, Montana.

Experienced fire managers know that the surest way to control conflagration fires is to prevent them in the first place. Yet, wildland fire prevention is given only token emphasis in terms of allocation of resources and financing, in most wildland management agencies in the United States.

Historically when conflagration conditions occur, some fires start and the prevention organization is quickly assigned to fire suppression duty. Prevention of the next fire is then nearly impossible.

One reason for this lack of emphasis on fire prevention is that historically, predicting the chance of a wildfire starting has not been possible with any reliability, and efficient operational systems for fire prevention have not been developed and applied.

This paper describes a first-time test on a conflagration forecasting system and the application of total mobility, or move up systems to the prevention of conflagration fires.

CONFLAGRATION FIRE PREVENTION COORDINATION PLAN

In August 1978, the USDA Forest Service's California Regional Forester approved the Conflagration Fire Prevention Coordination Plan.

The plan focused on the four southern California National Forests:

1. Angeles National Forest
2. San Bernardino National Forest
3. Cleveland National Forest
4. Los Padres National Forest

The plan outlined the criteria for implementation of, and the action to be taken by intensified fire prevention systems during periods of extreme fire danger. The overall objective of the plan, and action, was to reduce the likelihood of the occurrence of large disaster wildfires--the conflagrations.

CONFLAGRATION EARLY WARNING SYSTEM

Each of the four southern California National Forests was separated into areas of low, moderate, high hazard and exempt areas.

Exempt areas were those relatively "fire safe," such as large expanses of rock and/or barren ground.

Hazard areas were classified on the basis of:

1. Predicted rate of spread.
2. Spotfire potential.
3. Presence of fine ground fuels, easily ignited.
4. Continuity of fuels which would permit spread over large areas.
5. Presence, or absence, of manmade barriers.
6. Resistance to suppression factors, such as machine operability, access.
7. First run damage potential of a fire that starts.

CRITERIA FOR PLAN ACTIVATION

Criteria for activation was based on the hazard areas, previously discussed, the two principle southern California fuel models, rate of spread potential and the computer-based analysis of fire report data.

The potential rate of spread was set at 80 chains per hour. This spread rate could be expected to result in a 300-acre fire in 1 hour when average slope percent and spotfire potential was included.

The two computer assisted programs were:

1. "Crosstabs" which allows for cross tabulated analysis of Forest Service fire report data where a constant (number of smoker fires) is analyzed against several variables (such as time of day, fuel types, or locations). The analysis is helpful for longer range planning purposes.

2. "Prevent Query" which allows for continuous monitoring of day-to-day fire occurrence within each of 300 fire prevention units in the National Forests in California. "Prevent Query" makes possible the comparison of current fire occurrence trends to the historic trends obtained from "Crosstabs" analysis of individual fire reports.

IMPLEMENTATION OF THE PREVENTION ACTION PLAN

On September 15, 1979, worsening fire danger conditions in southern California resulted in high hazard National Forest areas meeting the criteria for the implementation of the conflagration prevention plan. Ninety-eight prevention specialists from the Forest Service North Zone (northern California) and the Pacific Northwest Forest Service Region (Oregon and Washington) and from the Bureau of Land Management were dispatched to southern California for saturation wildfire prevention activities.

PREVENTION COORDINATION CENTER

A Prevention Coordination Center was set up by the South Zone Coordinator at Riverside, California, Zone Headquarters. National Forest fire prevention officers requested prevention task force units through the coordinator.

PREVENTION TASK FORCES

The 98 prevention specialists were organized into task forces and units. A task force consisted of five radio-equipped fire prevention units. A fire prevention unit was two prevention specialists in a pickup/pumper unit.

RISK FORECASTING CENTER

The Risk Forecasting Center was set up at the U.S. Forest Service Riverside Fire Research Laboratory. The forecasting operation consisted of a team of analysts (statistical and computer specialists) and a team of strategists/tacticians (fire behavior officer/weather forecaster).

Fire occurrence forecasts were made by the team of analysts by National Forest, by Ranger District, and by cause.

A problem summary was prepared by the team of strategists and prevention action was recommended. Appendix 1 is an example of a fire occurrence forecast and problem summary.

FIRE PREVENTION TASK FORCE ACTION

The task force teams were assigned to prevention activities on the basis of the occurrence forecasts. The task forces augmented the regular Forest prevention crews for:

1. Saturation patrols.
2. Public contacts in high risk areas.
3. Road closures.
4. Contacts with local newspapers and television.

THE PAYOFF FROM THIS FIRST-TIME CONFLAGRATION PREVENTION PROGRAM.

1. Arson fires which were of high frequency on at least two of the forests were eliminated during the high fire danger period.

2. The units had "implied enforcement" effect on all four of the Forests, as reported by the Forest prevention officer.

3. On one National Forest the prevention units discovered three incipient wildfires and carried out successful initial attack.

4. On one Forest, fire prevention units made successful initial attack on 10 wildfires. Each prevention unit, with its pickup/pumper, radio communication, and tools could act as a fire suppression unit also.

The cost of this first-time experimental conflagration prevention project was $235,000. The estimated suppression costs saved by the intensified prevention action totaled $2.3 million.

The task force teams were assigned on the basis of the forecasts and carried out saturation prevention measures.

Prevention units (five to a task force) consisting of two prevention specialists with a radio-equipped pickup/pumper also detected fires and made initial attack on 10 wildfires.

The cost of this first-time experimental conflagration prevention project was $235,000. The estimated suppression costs saved totalled $2.3 million.

Appendix 1

Date: September 27, 1979

Fire Occurrence Forecast for the Week of September 29 to October 6, 1979
by
Fire Prevention Research Unit of PSW

San Bernardino National Forest

Summary:

The chance of one or more fires this week is: 0.947

The most likely causes are:

a. Equipment
b. Smoking
c. Campfires
d. Incendiary
e. Children

The chance of one or more fires during Saturday or Sunday is: 0.812

The chance of one or more fires on any weekday is: 0.732

The most likely occurrence for the week is 1 to 5 fires.

Summary by Ranger Districts

The chance of one or more fires this week is:

Cause	Arrowhead RD	Big Bear RD	Cajon RD	San Gorgonio RD	San Jacinto RD
Equipment	.10		.30		
Smoking	.59	.32	.10		
Campfires		.35	.13	.12	
Debris					
Railroad			.14		
Incendiary	.46		.42	.43	.10
Children	.56	.55			
Miscellaneous	.20				
Total	.86	.76	.70	.45	.22

FIRE PREVENTION PROBLEM ANALYSIS SUMMARY
for
San Bernardino National Forest

September 29-October 6, 1979

Problem Summary

The chance of one or more fires starting on the forest during the following week is almost certain. There is a high probability of incendiary fires based upon trends of the last week. Equipment use fires and smoker fires show moderately high chances of occurrence. Incendiary fires will most likely occur on the San Jacinto and Arrowhead Ranger Districts and the Santa Ana River drainage of the San Gorgonio District. The chance of equipment use fires is highest on the Cajon District. Campfires and smoker fires may occur on the Arrowhead, Big Bear, San Gorgonio, and San Jacinto Districts.

Analysis of historical data indicates:

1. The chance for an incendiary fire over 300 acres is greatest on the San Jacinto District.

2. Transients cause 58 percent of all incendiary fires, but local permanents may cause 17 percent. Visitors cause 17 percent also.

3. The odds are that most incendiary fires will start between 1100 and 1700. The chances are 3/10 that an incendiary fire may start between 0300 and 0600, however.

4. Though 84 percent of all incendiary fires had little or no "degree of preventability," 16 percent of them might have been prevented. Personal contact was the recommended activity.

Prevention Action

Equipment use, smoker fires, and fire caused by campfires can be prevented.

1. Check stations on the San Gorgonio and San Jacinto Districts.

2. Campground patrol.

3. Personal contact on all industrial operations.

Some incendiary fires can be prevented.

1. Intensify patrols between the hours of 1100 and 1700 and 0300 and 0600.

2. Contact local permanents, especially on the San Jacinto and San Gorgonio Districts.

3. Establish check stations with the help of the local sheriff's office.

Analysis by: Jim Murphy

FIRE HAZARD REDUCTION PROGRAM IN THE HILL AREA OF THE UNIVERSITY OF CALIFORNIA AT BERKELEY

Carol Rice and Elaine Bild

ABSTRACT: The University of California at Berkeley has instituted a five year program to reduce the fire hazard in the 1500 acre Berkeley Hill Area. Treatments to reduce fire hazard are linked to the current vegetation types. Vegetation types include Monterey pine, grass, north coastal scrub, oak/bay woodlands, and thirteen year old sprouts of eucalyptus. Treatments consist of hand labor, prescribed burning, goat grazing, as well as cutting and chemically treating eucalyptus sprouts. Cooperation and involvement of local agencies and the community are an integral part of the program.

BACKGROUND

The University of California has a serious fire hazard above the Berkeley campus (i.e. the Hill Area). The vegetation in the Hill Area is often flammable. Not only is the volume of fuel large, but also much of it is dead. Valuable and reknown research facilities are almost universally located above slopes of natural fuels. The high recreational usage of the Hill Area increases the chance of ignition. In 1986 alone, for example, three arson fires burned in the Hill Area. Severe fire weather and steep slopes only compound the threat.

Fire protection capabilities have improved since a 1923 fire, in which 584 structures were destroyed. However, there have been other devastating fires since then. A fire in 1970 burned 39 homes just one ridge south of the UC Hill Area. Damage was estimated at $3.5 million. A fire in 1980 burned five homes northeast of the campus. It occurred December 14th, after fire season had closed. The first engine arrived in just six minutes, but four homes were already engulfed in flames. Damage was estimated at over one million dollars.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

Carol L. Rice is Proprietor, Wildland Resource Management, Walnut Creek, CA. Elaine Bild is Director, Office of Environmental Health and Safety, University of California, Berkeley, CA.

PLANNING PROCESS

A fire prevention committee was formed to aid in program planning and implementation. This committee has a diverse representation, including homeowners, local fire departments, as well as University adminstrative and academic departments. Goals for the preferred amount and arrangement of fuels as well as the distribution and successional stage for each vegetation type were agreed upon before site specific action plans were developed. Generally, the combined goals are to encourage native plants of low fire hazard.

THE PROGRAM

Prevention of a potential catastrophe is critical. This realization prompted the University Office of Environmental Health and Safety to initiate a five year program which prescribes and schedules activities to reduce the fire hazard. These activities include: biological and chemical treatments, hand labor, prescribed burning, and compatible land uses. In many situations, a combination of these treatments is applied.

Costs of methods vary widely, so proposed methods balance environmental impact, effectiveness of fire hazard reduction, and costs. Hand labor costs range from $200/acre to $1015/acre. Goat grazing ranges from $300/acre to $1000/acre. Prescribed burning ranges from $30/acre to $300/acre. Cutting and treating eucalyptus is estimated at $435/acre. This estimate incorporates expenses of $1415/acre to cut and chemically treat eucalyptus stumps, plus income of $850/acre from the sale of the boles of the trees as firewood.

The highest priority areas to treat are those on the University borders and those adjacent to high value facilities. These areas are scheduled to be treated first. The activities as well as their scheduling and placement incorporate concerns for fire safety, environmental protection, and cost efficiency.

Management activities to reduce fire hazard either change the vegetation type or reduce the fuel volume within a vegetation type by: (1) reducing total amount present to burn; (2) spacing the vegetation (both horizontally and vertically) so flames have to reach farther to continue their spread; and (3) reducing flammability of the fuels. A mixture of these methods is often used.

The UC Hill Area encompassed two dairy farms in the 1800's. Fuel treatments such as eliminating eucalyptus sprouts and reduction of brush cover reconstruct a more natural ecosystem. This aspect of the program is doubly important in a large portion of the Hill Area designated as an Ecological Study Area.

Input from several experts was invited to clarify environmental concerns. Some interested parties believe there is no fire problem in the Hill Area which warrants any action. Consideration of all concerns resulted in the establishment of a wildlife refuge, preservation of an area of each vegetation type in an untreated condition, and treatments to further protect local fauna.

PLANS

Management treatments are linked to vegetation types because fire burns through each type differently.

In Monterey pine (Pinus radiata) stands, hand labor will be used to clear out undergrowth, then prescribed fire will be used to reduce dead and down material. Thus the mature stand will be left intact.

Most oak/bay woodlands will receive no treatment because they are not a major fire hazard. We will separate the canopy from ground fuels by six feet or more in woodlands adjacent to homes.

We will conduct prescribed burns in grasslands below structures before July 4th every year. Other grsasslands will be burned at five year intervals in a manner that will promote conversion of exotic annual to native perennial grasses.

In areas with permanent fences, where hand labor is not economical, or in areas of poison hemlock (Conium maculatum) and poison oak (Toxicodendron diversalobum), a herd of goats will be grazed. Approximately 600 goats are concentrated in a fenced area for a short period of time in order to reduce the plant volume and fire hazard. While non-traditional in most fire hazard reduction programs, this treatment has proven to be quite successful in an urban/wildland setting.

In 1972 a freeze killed the branches of eucalyptus and 100 acres were cut with the belief they were totally dead. As result, the sprouts now constitute the worst fire hazard in the Hill Area. We will convert the areas of eucalyptus (Eucalyptus globulus) sprouts to grass on south slopes and oak/bay woodlands on northern aspects. This entails cutting the boles and selling the boles as firewood or chips. Leaves and branches will be left to dry and will be burned in the spring. This treatment has an aspect of urgency because a eucalyptus beetle (Phoracantha semipunctata) is moving north from Southern California. The beetle girdles the tree, changes the growth form of the trees to brush and renders the wood unsalable. Prescribed fire will be used in areas of mature eucalyptus to maintain an open canopy and low amount of fine fuels.

We will rejuvenate decadent stands of north coastal scrub, or promote the natural advancement to oak/bay woodlands. Shrub cover will be reduced to 20% intermixed in rocky outcrops and in grass.

Approximately 65 acres are scheduled to be treated in the first year, 200 acres in the second, gradually decreasing to 71 acres the fifth year. The cost of implementation rises from $26,000 the first year to $54,500 the second, then tapers to $11,000 the fifth year. An estimated 40 percent of the fire management costs can be attributed to precautions taken to minimize environmental impact.

RESULTS

Fire intensity (as measured by flame length) is predicted to decrease approximately 50% as a result of the management activities. This further indicates an increase in the ability of suppression forces to control the fire. The most dramatic improvement in fire safety is expected to occur from the eradication of eucalyptus sprouts.

Meetings with homeowner groups and the involvement of the diverse fire prevention committee have been an essential part of the program's success. Other public affairs activities are also being performed, including coordination with the news media.

The first year of the program is proceeding well. Approximately 50,000 hours of hand labor were spent on this program by the California Conservation Corps. These young adults have pruned and thinned stands of pine and eucalyptus as well as built fire lines, all in anticipation of prescribed burns. We have conducted two prescribed burns, both bordering homes. The first was a prescribed burn in a Monterey pine stand. The second was in a combination of grass, eucalyptus and brush. We also grazed 600 goats, concentrated in areas where other manipulation was not feasibile. Public response has been enthusiastically supportive; goat grazing has been the most popular method and concerns over smoke and blackened hills is minor. Although opposition to other eucalyptus eradication programs exists elsewhere, so far, local homeowners have met this restoration project with favorable response. A site-specific eucalyptus removal plan is being developed. Poison oak presents the most major obstacle at this time, for it limits hand work in areas where it is prevalent. A third prescribed burn across the street from the football stadium is to occur as soon as weather permits.

Cooperation is integral to the plan. The program benefits many sectors of the community. A UC professor conducts prescribed burns as an educational tool. The California Conservation Corp is heavily involved. Local fire departments (especially that of the Lawrence Berkeley Laboratory) assist in prescribed burns, providing firefighters and equipment. Faculty and students will realize increased opportunity for research and educational activities in the Hill Area. Much of the area made inaccessible by brush will be more open to recreationists. Homeowners have given this plan solid support. Nature enthusiasts appreciate the restorative aspect of the program.

PROTECTING PEOPLE AND PROPERTY FROM FIRES IN WILDERNESS

James M. Saveland

ABSTRACT: Wilderness is "recognized as an area where the earth and its community of life are untrammeled by man." Thus, one of the objectives of wilderness fire mangement plans is to permit lightning caused fires to play their natural ecological role within wilderness. However, one of the most important elements in a wilderness fire prescription is safeguarding people and property.

There is considerable uncertainty surrounding a decision to permit a lightning fire to burn under prescription, not knowing what the weather will be like for the remainder of the fire season. There is a certain amount of risk inherent in each decision. Risk management includes identifying the risks, assessing the probabilities and consequences of various events, and evaluating risk mitigation measures. Decision theory provides an excellent framework to identify and quantify the risk management process.

Protection concerns in wilderness include visitor safety and permitted operations, such as outfitter camps and private in-holdings. Government property, such as ranger stations, trail bridges, and lookouts, need protection too. Risk mitigation measures include educating the public about wilderness fire programs, taking suppression action against fires that pose a threat, and informing the public of the current fire situation as it develops via signing, personal contact, and the media. Trail closures are often necessary in the vicinity of a fire, and airfields have been temporarily closed in the past because smoke has restricted visibility. Planned ignition prescribed fires may be necessary in some wilderness areas to further reduce risk.

The problem of protecting people and homes from wildfire is not limited to wildland residential areas. Many of the same problems exist in more remote settings. There are many lessons to be learned from how established wilderness fire programs have already dealt with this problem.

Poster paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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RELATIONSHIPS OF WATER, WET WATER, AND FOAM TO WILDLAND-URBAN INTERFACE FIRE SUPPRESSION

Paul Schlobohm and Ron Rochna

ABSTRACT: Consequences of recent fires demand more effective means of fighting wildland-urban interface fires. Fire suppression properties of water, wet water, and foam are examined as they influence application guidelines. Modern water attack requires high flow rates. Wildland foams combine the best attributes of water, wet water, and other foams. Indirect water attack on structures may have practical applications for wildland foam in the interface. Water should not be used to fight fire without a surfactant.

INTRODUCTION

The wildfires in California and Oregon during the late summer of 1987 were devastating reminders of the conflicts created by homes in the wildland.

Nine lives, over 60 structures, and at least 850,000 acres of timber were lost in California alone (Rios, 1987). The large number and size of the fires quickly depleted resources. Suppression strategies necessarily shifted to human and structure protection at the expense of timberlands. The increased need for property protection and efficient resource use attracted much attention to wildland fire foams.

To understand the merits of wildland foams as a tool for fire suppression in the wildland-urban interface, an examination of the development and use of foam for firefighting is appropriate. The relationships of plain water and its foam additives are shown in table 1.

Current wildland and structure fire suppression efforts in the United States rely almost entirely on plain water. The most common water additives include aerial retardants for wildland fires, and vapor suppressant foams for industrial and crash fires. Wet water is used sparingly for mop-up by wildland and urban fire forces. Foam for wildland fires has a small and growing following.

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WATER

Water has been recognized as a means of suppressing fire since rain was first observed extinguishing the warming fires of early man. Water is transportable. It is neither corrosive, toxic, nor reactive. Water has one of the highest cooling capacities; requiring the absorption of 9330 btu per gallon as it boils and then becomes steam. Layman (1955) found the conversion of water to steam to be 90 percent efficient with high pressure and low water flow. Layman's rapid, low water flow tactics which did not include structure entry, may have applications for the wildland-urban firefighter. The water droplets he projected into superheated spaces expanded 1600 times to steam forcing heat and oxygen out of the building.

With the advent of breathing apparatus in the 1960's, Grady (1987) notes that structure fires have been attacked from inside and out. Moving personnel inside necessarily changed water flow tactics to prevent injury from superheated steam. Water streams were applied directly to the fire, requiring more applications, and more water than before. The Iowa formula is the current water flow guide for interior structure attack:

$$\text{gallons per minute} = \frac{\text{cubic feet of largest room}}{100}.$$

The molecular structure of water influences its vaporization and effectiveness as a fire suppressant. Each molecule has two hydrogen atoms bonded asymetrically to one oxygen atom. The resulting polarity gives the molecules a strong mutual attraction manifested in a high surface tension of 73 dynes/cm at 20°C. Strong surface tension forms water into beads or drops rather than films. Because of water's surface tension, utilization of water droplets to make steam and cool fire is rarely complete. Haessler (1974) notes that a solid stream of water is 5-10 percent efficient at actual extinguishment. The Iowa Formula has a built-in effectiveness factor of 40 percent (Grady, 1987).

Another gauge of water effectiveness is the water flow rate required by the Insurance Services Office (1980). For a 1-2 family dwelling not exceeding two stories in height and at least 100 feet from other dwellings, the Office states that 500 gallons per minute must be available to protect this house.

Table 1--Relationships of water, wet water, and detergent-based foams

	WATER						
Add	Nothing	Surface Active Agent					
Agitation?		No Agitation	Agitation				
Result	WATER	WET WATER	MECHANICAL FOAM				
			Common Features				
Type of Foam			Wet Water Foam	Detergent Foam	Wildland Foam	High and Medium Exp. Foam	Aqueous Film-forming Foam
Date Introduced		1950's	1950's	1930's	1980's	1950's	1960-70's
Surface Tension (dynes/cm)	73	25-33					16-19
Mix Ratio (%)		0.05-0.1	1,3,6	1,6	0.2-0.7	1,3	3,6
Major Use: Fuel Class and Applications	A: -Extinguishment -Mop-up	A: -Mop-up: wet charred fuels and textiles	A & B: -Bulk Fuel fires -Rapid knockdown	A & B: -Combination use for departments with variety of fuels	A & B: -Wet charred, uncharred, dead, living fuels -Exposure insulation -Rapid knockdown -Mop-up	A & B: -Confined space fires -Exposure insulation	A &/or B: -Aircraft crash control -Rapid knockdown -Diked fuel spills -Polar solvents

The specific gravity and heat transparency of water also affect its use. Because most hydrocarbons have a lower specific gravity, they float on water. Therefore, water has no resistance to reignition and flashback. Since water is a poor reflective barrier to radiant heat, continuous, high volume water flows are necessary for exposure protection.

SURFACTANTS

To improve the wetting, penetrating, and durability characteristics of water, man has been adding surface active agents for over fifty years (Ratzer, 1956). The surface active agent, or surfactant, reduces the surface tension of water to 17-30 dynes/cm, allowing elasticity of water surfaces and greater mobility of water molecules. Surfactants have been developed for specific functions on certain fuels. A surfactant made to adhere as foam to plastics, for example, will differ from one made to create a film seal over petroleum products.

Surfactants for firefighting can be roughly grouped as either wetting agents or foaming agents. Wetting agents increase the spreading ability of water and usually are not designed for use as foam. Surfactant foaming agents have wetting agent properties and permit the formation of clinging bubbles. These products are detergent-based.

Foam can also be made with bubble stabilizers derived from protein matter. These include chemical, protein, and flouro-protein foams. These foams have great bubble stability but do not share the wetting and penetrating characteristics of surfactant foams.

Wet Water

The basic form of surfactant-treated water for improved extinguishing efficiency is wet water. Wet water is defined as water to which a wetting agent has been added (NFPA 18). Wet water products first became available after the Second World War (Bryan, 1982). Wetting agent wet waters are approved by the United States Forest Service for use on decaying and charred Class A fuels only. Some wet waters will create a frothy wet water foam when mechanically agitated with air. These foams have rapid drain times and are used on bulk fuel fires. The National Fire Protection Association (1962) explained and demonstrated how wet water and wet water foams are more effective for fire suppression than plain water. Davis (1951) shows a wetting agent to be three times more effective than plain water on wood-burning fires.

The words "wet" and "wetting" are loosely used to mean penetrating and spreading. Wet water surfactants spread water by reducing surface tension. Textiles and other water porous materials can be wetted by this filming action of wet water. Detergent-based foaming agents not only spread the water, but also use a solvent to promote penetration through water-resistant plant surfaces.

Mechanical Foam

The largest type of treated water for fire suppression, mechanical foam, was first made in 1904. Detergent-based foaming agents for mechanical foams appeared in the 1930's (Bryan, 1982). Mechanical foams require a device to mix air with foam solution and allow for desired bubble expansion. Apparatus that provide these features include: 1) an aspirating nozzle with expansion tube, 2) an air compressor, pipe tee and length of hose or mixing chamber, and 3) turbo jet or water-agitating nozzle. Aspirating nozzles are almost universal. These nozzles use a venturi to pull air into the solution as the stream is being atomized into an expansion chamber. Foaming agent is usually mixed by eduction. Large water flow through these nozzles require large concentrate flow at the eductor. A deterrent, therefore, to most foam use is the large space required on an engine to carry sufficient agent for its task.

The compressed air foam system (Schlobohm and Rochna 1987) brings air and water together at equal pressures near the pump and compressor. With air in the hoselay, water flow is one-third less than without. Wildland foam agents are made at high concentration, and mix ratios are 1/10 - 1/20 of other foams, making agent storage space practical.

Recommended expansion ratios for mechanical foams range from 8 and 10 to 1 for wildland foams to 200 and 1000 to 1 for high and medium expansion foams. However, detergent, high and medium expansion, and wildland foams show very similar expansion characteristics for a given apparatus (Hubert). At a mix ratio of 0.3 percent, 1 gallon of wildland foaming agent can turn 300 gallons of water into 3000 gallons of foam.

Wildland Foam--As a relative newcomer to the mechanical foam group, wildland foam combines some of the best attributes of its cousins. Wildland foam retains the heat absorption of water and the spreading characteristics of a wetting agent. Like other detergent-based foams, wildland foam penetrates all Class A fuels. Its ability to cling to surfaces enables penetration, reflection of radiant heat, and suppression of oxygen. With other foams, wildland foam shares vapor suppressant and rapid flame knockdown capability. What wildland foams do not share with any other medium is performance per gallon of water. This is mainly because of the compressed air foam system (CAFS) attempted by Peterson and Tuve (1956), and revived by Ebarb (1978). Unlike aspirating nozzles, compressed air systems convert 90 percent of the water to foam. Systems of 40 cfm provide instant knockdown from 90 feet with 35 gallons per minute of water as foam.

Wildland Foam and the Compressed Air Foam System--With the compressed air foam system, wildland foams become a valuable tool for fighting fires in the wildland-urban interface. Water conservation is a key feature. A limited water supply cannot only be expanded, but because of the expansion, the water also becomes more effective. There are applications for both the firefighter who must drive to a distant water source, and the woodland homeowner who may have a finite water supply in a pond or pool. High agent concentrations and low mix ratios (3 gallons/1000) permit adequate on-board storage without reducing engine water capacity. Hoses, filled with foam, are light and maneuverable.

The clinging, wetting, and reflecting properties of wildland foam make exposure protection perhaps its most important application. Compressed air provides the discharge distance to reach and the agitation to cling to walls, eaves, roofs, and trees. Small, portable pumping systems can give the homeowner a method of on site structure protection.

Compressed air wildland foam may have applications for protection of residential fuel tanks. These foams have also been shown to be effective extinguishing small liquid fuel spill fires.

Another application for wildland foam with the compressed air system in the interface may be structure attack. Layman (1955) developed the indirect attack for structures using rapid, low water flows into superheated spaces and watched fires go out without entering buildings. On urban training fires over the past two years, the compressed air foam system has duplicated this feat.

CONCLUSION

Utilization of water for fire suppression has not changed over the centuries, with few exceptions. The fact is that use of any additive with water is the exception. AFFF and related film-forming foams occupy a small niche of specific duties on liquid fuel fires. Thickeners, such as retardants, are accepted for aerial use on wildfires large enough to justify expense, but development of new technologies, such as residential sprinklers, continues to be water oriented. Wildland and structure fires are primarily fought with plain water. And, although structure fire personnel rely on documented formulas for water use, wildland firefighters do not have a guide for water use.

Acceptance of water additives to improve efficiency will not occur overnight. The advocacy of surfactants in the literature for over 50 years and their continued limited use indicates a strong tradition of water use. This same advocacy would seem to necessitate justification of plain water, not surfactant. The integration of strategies and technologies of wildland and urban fire services may present the forum necessary for the social, political, and economic change from water to wet water and foam. Regardless of application or apparatus efficiency, water should never be used to fight fire without a surfactant.

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FOREST FIRE CLOSE TO HOME: TERRACE BAY FIRE #7/86

B. J. Stocks

ABSTRACT: Terrace Bay Fire #7/86 occurred on the afternoon of May 21, 1986 near the small pulpmill town of Terrace Bay, located on the north shore of Lake Superior 225 km east of Thunder Bay, Ontario. A persistent lack of precipitation, combined with strong winds, low humidity levels, dry ground vegetation, and low crown foliar moisture contents, resulted in extreme fire danger conditions in the Terrace Bay area. The fire crowned immediately, spread rapidly toward the town, and caused the hasty evacuation of 500 residents. Aggressive ground attack, with the support of five heavy water bombing aircraft and eight helicopters, stopped the forward progress of the fire at the edge of town. The final fire size reached 200 ha, but no building or property loss occurred.

INTRODUCTION

Since the advent of organized forest fire suppression in Ontario early in this century, tremendous strides have been made in the detection and control of wildfires. During the past decade an average of 91 percent of all fires have been contained at less than 4 ha in size. A glance at the landscape of northern Ontario, however, will attest to the fact that periodic large wildfires continue to be the dominant force in shaping forest composition in this area. An appreciation of this fact, and an understanding that severe wildfires can and will continue to occur intermittently in spite of modern and sophisticated fire management technology, is essential to residents of northern Ontario. The evacuation of numerous towns and villages and the destruction of many cottages and recreational facilities over the past 10-15 years have served to emphasize this fact dramatically.

This paper describes a relatively small (200 ha) fire that occurred adjacent to the town of Terrace Bay, located on the Trans-Canada Highway on the north shore of Lake Superior, 225 km east of Thunder Bay, Ontario. Terrace Bay is a typical northern Ontario pulpmill town with a population of approximately 3,000. Known as Terrace Bay Fire #7/86, this fire occurred on the afternoon of May 21, 1986 under conditions of extreme fire danger; it burned quickly through a forested area adjacent to Terrace Bay and reached the edge of the town before it was brought under control. Although fast and effective fire suppression activity prevented loss of property, the fire forced the temporary evacuation of 500 residents.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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WEATHER AND FIRE DANGER RATINGS

Daily (1300 h local daylight time) weather observations recorded at the federal Atmospheric Environment Service (AES) weather station located at the Terrace Bay airport, approximately 3 km northwest of Terrace Bay Fire #7/86, are presented in table 1. The calculated fuel moisture codes and fire behavior indices of the Canadian Forest Fire Weather Index (FWI) System (Anon. 1984) are also shown in table 1 for the period between May 1 and May 21, the day on which the fire occurred. Despite relatively cool temperatures throughout May, the lack of precipitation during the two weeks prior to May 21, combined with high winds and low relative humidity levels during the five days immediately preceding the fire, resulted in extreme fire danger conditions on May 21. Fine Fuel Moisture Code (FFMC) and Initial Spread Index (ISI) levels were extreme (93 and 24, respectively) and this, in conjunction with a moderate Buildup Index (BUI) of 32, ensured that fires would ignite easily and spread very rapidly in the Terrace Bay area on the day of the fire.

Hourly weather observations from the Terrace Bay airport for the morning and afternoon of May 21 are shown in table 2. Temperatures were normal for the season but relative humidity values were quite low throughout the day; relative humidity dropped from 40 percent at 0800 h to 13 percent by 1600 h. Strong, gusty winds from the east-northeast prevailed during the afternoon, with average windspeeds of 25-30 km/h and gusts in excess of 40 km/h. The area was under the influence of a large ridge of high pressure centered 400 km north of Terrace Bay; skies were clear, and the atmosphere was unstable. Hourly weather observations confirmed the fact that weather and fuel moisture conditions were conducive to extreme fire behavior on May 21.

Table 1--Daily 1300 h weather observations and calculated fuel moisture code and fire behavior indices of the Canadian Forest Fire Weather Index (FWI) system for the Terrace Bay Airport AES weather station

Date	Dry-bulb temp. (°C)	Relative humidity (%)	Wind velocity (km/h)	Wind direction (degrees)	Rain (mm)	FWI System components[a]					
						FFMC	DMC	DC	ISI	BUI	FWI
May 1	-4.3	22	26	20	0.0	87.3	6	17	10.8	6	9
2	0.4	75	11	10	0.0	84.0	6	20	3.2	7	3
3	9.5	23	19	350	2.3	77.7	7	24	2.4	8	2
4	5.6	93	7	170	0.0	77.0	7	27	1.2	8	1
5	6.4	93	28	90	1.3	65.4	7	31	2.2	9	2
6	12.2	63	22	120	12.4	49.6	4	17	0.5	5	0
7	6.7	67	22	30	0.0	66.9	5	20	1.7	6	1
8	11.8	34	19	90	0.0	82.6	7	25	4.0	8	4
9	12.0	63	15	160	0.2	83.4	8	29	3.6	10	4
10	10.9	67	9	150	0.0	83.5	9	34	2.7	11	3
11	14.8	36	15	150	0.0	87.7	12	39	6.6	14	8
12	8.4	94	9	140	0.0	79.8	12	43	1.8	14	2
13	7.2	80	9	130	0.0	79.9	13	46	1.8	15	2
14	15.1	53	13	180	0.0	84.2	15	52	3.7	17	5
15	12.8	89	9	160	0.0	80.6	15	56	1.9	18	3
16	13.8	75	13	230	0.0	81.4	16	61	2.6	19	4
17	14.2	43	20	230	0.0	86.1	18	66	6.8	22	11
18	12.2	44	24	30	0.0	86.9	20	71	9.2	24	14
19	11.0	27	22	90	0.0	89.5	23	75	12.0	26	18
20	15.6	18	20	70	0.0	92.5	26	80	16.8	29	24
21	17.8	20	26	70	0.0	93.0	30	86	24.2	32	33

[a]FFMC, Fine Fuel Moisture Code; a numerical rating of the moisture content of litter and other cured fine fuels. DMC; Duff Moisture Code, a numerical rating of the average moisture content of loosely compacted organic layers of moderate depth. DC, Drought Code, a numerical rating of average moisture content of deep, compact, organic layers. ISI; Initial Spread Index, a numerical rating of the expected rate of fire spread (combines FFMC and wind). BUI; Buildup Index, a numerical rating of the total amount of fuel available for combustion (combines DMC and DC). FWI; Fire Weather Index, a numerical rating of fire intensity (combines ISI and BUI) that is used as a general index of fire danger.

FIRE ORIGIN AND BEHAVIOR

The first report of smoke from Terrace Bay Fire #7/86 was received at the Ontario Ministry of Natural Resources (OMNR) fire attack base in Terrace Bay at 1402 h on May 21; it described a fire approximately 2 km east of town alongside the Canadian Pacific Railway (CPR) tracks. Subsequent reports indicated a rapid increase in the amount of smoke visible from town, evidence that the fire was well established and spreading quickly. This seems reasonable in view of the strong winds and dry conditions that prevailed at that time; furthermore, ground vegetation had not yet flushed and crown foliar moisture content levels were at a springtime low.

Railway maintenance operations were under way along the CPR line east of Terrace Bay at the time the fire was reported; although there is strong evidence that people or actions associated with this operation were the cause of the fire, this point is being disputed by the CPR and the case is now before the Ontario provincial courts. However, an investigation of the fire perimeter along the south side of the CPR tracks indicated that the fire originated alongside the railway line, at

Table 2--Hourly weather observations recorded on May 21, 1986 at the Terrace Bay Airport by AES personnel

Local time	Dry-bulb temp. (°C)	Relative humidity (%)	Wind velocity (km/h)	Wind** direction (degrees)
0800	8	40	20	060
0900	11	32	18	060
1000	13	28	26 (37)***	060
1100	13	31	26 (37)	060
1200	17	24	29 (43)	080
1300	18	21	26 (37)	070
1400	19	18	26 (37)	070
1500*	--	--	--	---
1600	21	13	31 (46)	050
1700	21	14	23 (33)	050

*not recorded as a result of evacuation caused by Terrace Bay fire #7-86

**wind direction was estimated, as the direction recorder was not operable

*** maximum hourly gust

a point approximately 1.9 km east of the Terrace Bay highway overpass where the CPR line begins a 90° curve to the north (fig. 1). At this location small conifers immediately alongside the tracks exhibited minor fire damage, consistent with trees burned while the fire was in its initial, low-intensity phase. Southwest of the tracks, char heights on individual trees and tree clumps increased dramatically, and within 50-60 m of the tracks, full crown fire development had occurred. Visual observation by airborne OMNR fire control personnel assigned to Fire #7/86 supports this analysis of the fire's point of origin and direction of spread.

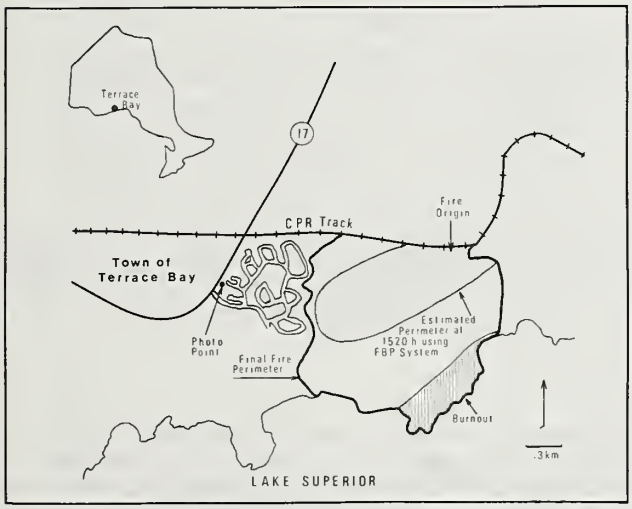

Figure 1--Location of Terrace Bay Fire #7/86 in relation to the town of Terrace Bay. Map shows the fire origin, estimated size and location at 1520 h on May 21, and the final fire perimeter.

Observers in helicopters and aircraft confirmed that the fire crowned and spread very quickly in a southwesterly direction. It reached the eastern edge of Terrace Bay at approximately 1520 h. If we assume that the fire was well established at the curve in the CPR line by 1410 h, then it spread a distance of 1.4 km in 70 minutes; this is equivalent to a forward rate of spread of 1.2 km/h. Tables and equations from the recently developed Canadian Forest Fire Behavior Prediction (FBP) System (Alexander et al. 1984, Lawson et al. 1985) allow us to predict the forward spread rates for Terrace Bay Fire #7/86. Fuels in the fire area, primarily black spruce *(Picea mariana* [Mill.] B.S.P.) and white birch *(Betula papyrifera* Marsh.), were typical of the boreal mixedwood fuel type. For fuel type M-1 (Boreal Mixedwood - leafless) in the FBP System, a predicted spread rate of 1.26 km/h is obtained if we assume a 50 percent softwood/50 percent hardwood mixture and use the measured ISI of 24.2 (fig. 2). This compares favorably with the observed rate of spread on the afternoon of the fire. The FBP System also permits estimation of the shape and area of the fire at 1520 h. For a windspeed of 26 km/h and a forward spread rate of 1.26 km/h, a length: breadth ratio of 2.35 and a size of 67 ha at 1520 h is obtained. The estimated fire perimenter at that time is shown in figure 1.

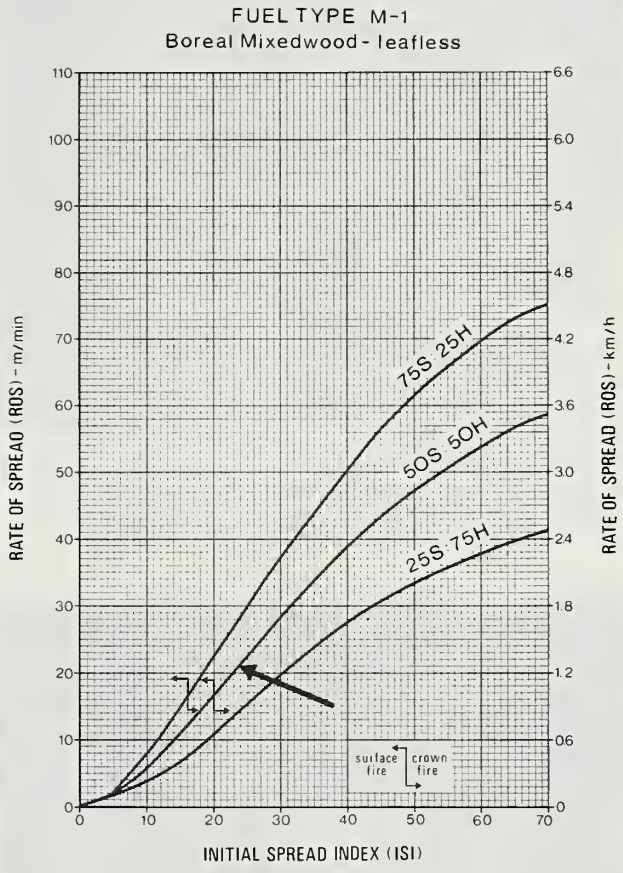

Figure 2--Rate of Spread / Initial Spread Index (ISI) graph for the Boreal Mixedwood (leafless) Fuel Type from the Canadian Forest Fire Behavior Prediction (FBP) System.

The final, almost-square shape of Terrace Bay Fire #7/86 was a function of the CPR tracks on the north side, a burnout operation from Lake Superior in the southeast corner, and suppression action on both the flanking and backing portions of the fire. The shape of the fire as it approached the eastern edge of Terrace Bay, as estimated according to the FBP System and confirmed by observers, was much more elliptical, which is typical of a fast-moving, wind-driven crown fire (Fig.1). Photographs taken from the town, which show the behavior of the oncoming fire, are presented in Figures 3 and 4.

SUPPRESSION AND EVACUATION ACTIVITY

Within moments of the reporting of Terrace Bay Fire #7/86, OMNR fire crews in the Terrace Bay area were dispatched to the fire, and air attack and helitack support were requested from the OMNR North Central Region Fire Centre in Thunder Bay. Heavy water-bombing aircraft were dispatched from bases in Geraldton, Armstrong, and Kapuskasing, and helitack units were sent from Thunder Bay, Geraldton, and Shebandowan. Because of the long distances involved some of this support arrived

Figure 3--Evacuation from the eastern subdivision of Terrace Bay at approximately 1500 h as Fire #7/86 approaches (photo credit: Gary Gusul).

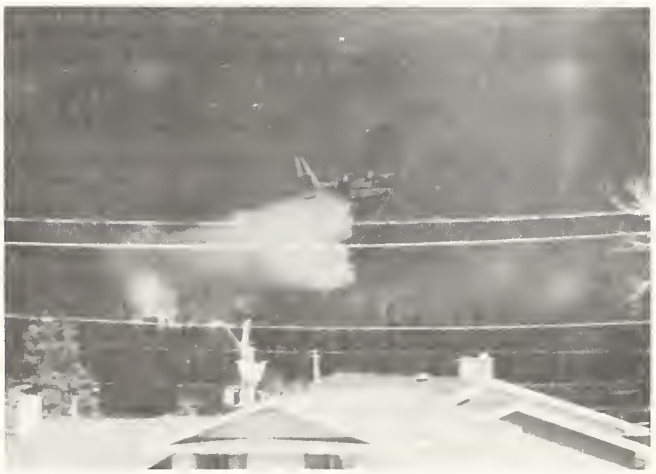

Figure 4--CL-215 waterbomber working on the southwestern edge of the fire at approximately 1515 h (photo credit: Gary Gusul).

after the head of the fire had reached the eastern subdivision of Terrace Bay. The forward progress of the fire was halted at this point, in part because of sparse fuels in the zone between the forested area and the subdivision, but primarily because of the highly effective use of water bombers (one CL-215 and two Canso PBY-5A's) and bucketing helicopters. The sparsely fueled buffer zone had not been deliberately created for protection purposes, but was the result of normal human activity in this area. As the fire approached, OMNR ground crews, with the support of municipal fire crews from Terrace Bay and the nearby town of Schreiber, were involved primarily in protecting properties in the parts of the subdivision that appeared most threatened. As additional support arrived it was used to control the flanks of the fire, suppress spot fires, bulldoze firebreaks, carry out a burnout operation from Lake Superior, and consolidate control lines. Although the fire was not brought under complete control until late in the evening of May 21, the threat to the town effectively ended when the main fire's run was halted. In all, a total of five heavy water bombing aircraft, eight helicopters, and eight OMNR fire crews worked on the fire.

As the fire approached the eastern subdivision of Terrace Bay, approximately 500 people were evacuated from 100 homes in that area and moved to other parts of the town. The evacuation notice was broadcast on local radio and by police just before 1500 h, and the relocation of people was prompt and orderly. Other residents in town, as well as the occupants of local businesses, schools, and hospitals, were placed on evacuation alert but were not relocated. People were allowed to return to their homes at 1900 h that night when the threat to the subdivision had subsided.

CONCLUSIONS

Terrace Bay Fire #7/86 underscored rather dramatically for the residents of Terrace Bay the very real danger and potentially catastrophic impact of forest fires on communities located in or close to forested areas. Under conditions of extreme fire danger, which are quite common in northern Ontario, particularly during the spring, fires can be ignited easily, can crown immediately, and can spread very quickly. That such fires will continue to occur is a foregone conclusion and it is unrealistic to expect that fire management agencies will always be able to respond as quickly and effectively as OMNR did in this case. Terrace Bay Fire #7/86 was detected very early, and water bombers that had been pre-positioned in areas of high fire danger were able to reach the fire very quickly. Once there, these aircraft worked in a coordinated and highly effective manner to halt the forward progress of the fire. A textbook operation such as this, in which everything went well, is not, however, something communities in forested areas should count on. It is essential that they comprehend the forest fire phenomenon fully, and work together to protect themselves and their communities. The people of Terrace Bay are at present working within their local Emergency Measures Organization to upgrade emergency communication and evacuation procedures, to create and maintain firebreaks around their community, and to work closely with OMNR to prevent future fires.

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PROTECTING HOMES IN AUSTRALIA

Andrew A. G. Wilson

Four hundred fifty houses were surveyed after the 1983 Ash Wednesday fire at Mount Macedon, Australia. Houses were more likely to survive when:

Fire intensity was low,
Householders extinguished fires near the house,
Roof material was tile or steel deck, rather than wood or corrugated iron,
Roof pitch was low,
Wall material was brick rather than wood,
Objects such as sheds or wood-heaps were not present near the house, and
Trees were not near the house.

The probability of house survival can be predicted using an equation. The equation and the research are described in the Journal of Environmental Management, Vol. 23, P. 259-270.

Poster Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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GUIDELINES FOR BURNING SPOTTED KNAPWEED INFESTATIONS FOR FIRE HAZARD REDUCTION IN WESTERN MONTANA

Gavriil Xanthopoulos

ABSTRACT: Spotted knapweed is a range weed that constitutes not only a grazing problem but also a serious fire hazard problem. Burning it efficiently for fire hazard reduction has proven difficult. Knapweed specific fuel models have been developed and guidelines are offered to help managers accomplish safe and effective prescribed burns.

INTRODUCTION

Spotted knapweed (Centaurea maculosa) is an introduced weed in the northwestern United States. It mainly invades dry sites with disturbed soil such as roadsides, trails, house yards, construction sites and overgrazed grasslands. In addition to causing grazing problems it constitutes a serious fire hazard problem.

The use of prescribed burning does not seem to be a promising control method for spotted knapweed because of its seed longevity. Burning spotted knapweed is attempted on many occasions, mainly in the spring, for fire hazard reduction purposes, around houses and other developments. Effective burns have proven difficult on many occasions, especially when fine grass fuels are not present, because fire does not carry through knapweed stems easily, under unfavorable conditions. On the other hand in some cases very intense fires have been observed in knapweed. The main reasons for this fire behavior are (Xanthopoulos 1986):

1. Extreme variation in spotted knapweed fuel loading between sites, and
2. Inclusion or not of standing knapweed stems as fuel available to the fire, depending on burning conditions.

FIRE BEHAVIOR MODELING

Existing stylized grass fuel models (models 1 and 3) (Anderson 1982) have been found to work poorly for spotted knapweed. To facilitate efforts to burn this weed regression equations allowing the calculation of fuel loading based on knapweed height and ground cover were developed and its characteristics as a fuel were determined (Xanthopoulos 1986). Fire modeling using these tools requires access to a fire behavior prediction system like BEHAVE (Burgan and Rothermel 1984) and can provide the user with accurate site specific predictions. In addition one can use fire behavior graphs that have been developed for three typical fuel beds of knapweed infestations, as burning guides without resorting to computer modeling (fig. 1-8).

The graphs have been developed for infestations of 30, 50 and 70 cm average standing knapweed height in western Montana, since height was found to correlate well with fuel loading. They have been developed for early spring burns, and do not include any live herbaceous fuel. If new spring growth is present, less intense behavior than predicted should be expected, or the fire will not carry at all. The graphs are valid if fine grasses are present with a canopy coverage of less than 40% (Xanthopoulos 1986).

The stylized spotted knapweed models were given numbers for easiest reference. Models 81 and 91 refer to 30 cm tall knapweed. Models 82 and 92 refer to 50 cm and models 83 and 93 to 70 cm tall infestations. Models 91, 92, 93 include both litter and standing knapweed loadings while the corresponding models 81, 82 and 83 include only litter. If the selection of the appropriate model is based on ocular estimation of standing knapweed, it should be noted that this estimate usually corresponds to the maximum height and should be reduced by approximately 30% (Burgan and Rothermel 1984). If the graphs for the eighty series models predict a flame length in the range 20-30 cm, fire should be expected to burn according to the ninety series models. Below the threshold of 20 cm flame length, fire will carry only in the litter according to the eighty series graphs, providing an incomplete burn.

The graphs are offered as guidelines to help the user select environmental conditions (wind, dead fuel moisture) that will allow safe and effective burns. The effect of slope can be combined with the effect of midflame windspeed, using the effective midflame windspeed graphs in figure 1 and 2 (Albini 1976). Fire modeling limitations, and loss of resolution by the use of stylized rather than site specific models should be realized. Care should be exercised in the application of these guidelines.

Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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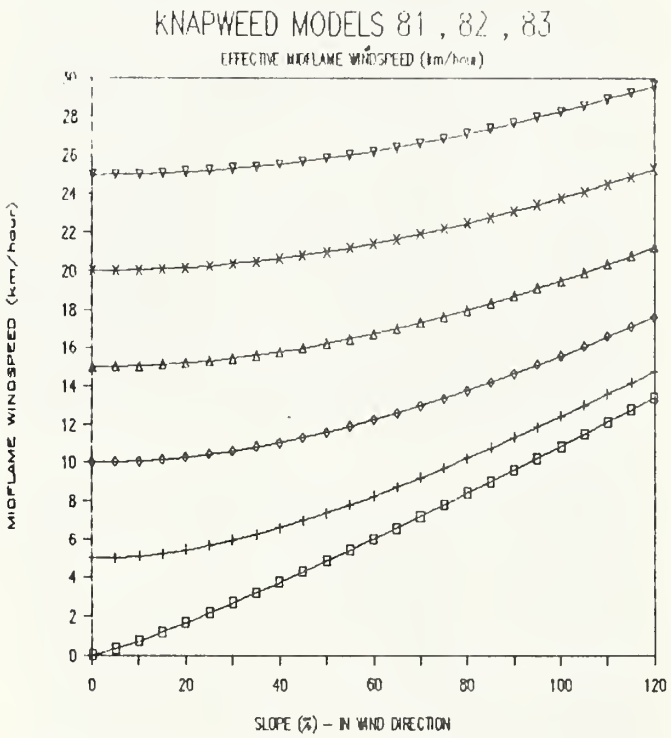

Figure 1--Effective midflame windspeed for fuel models 81, 82 and 83.

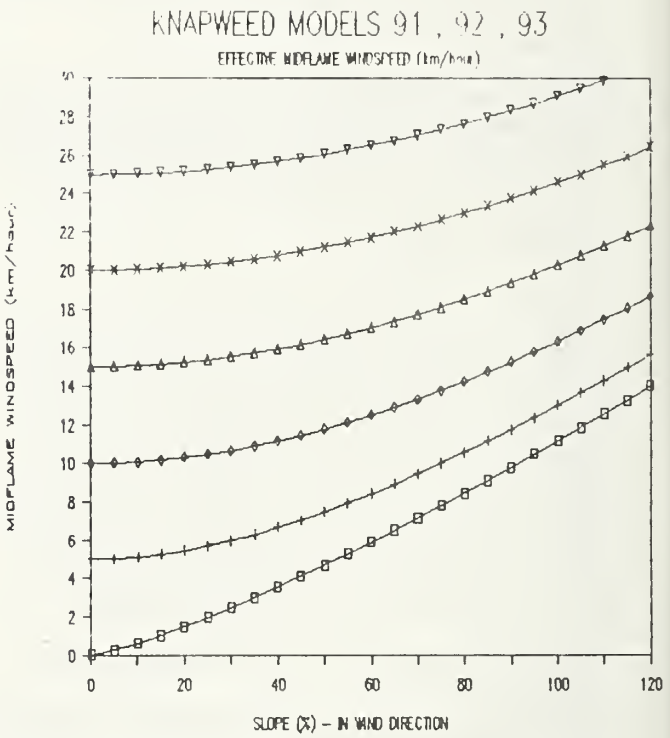

Figure 2--Effective midflame windspeed for fuel models 91, 92 and 93.

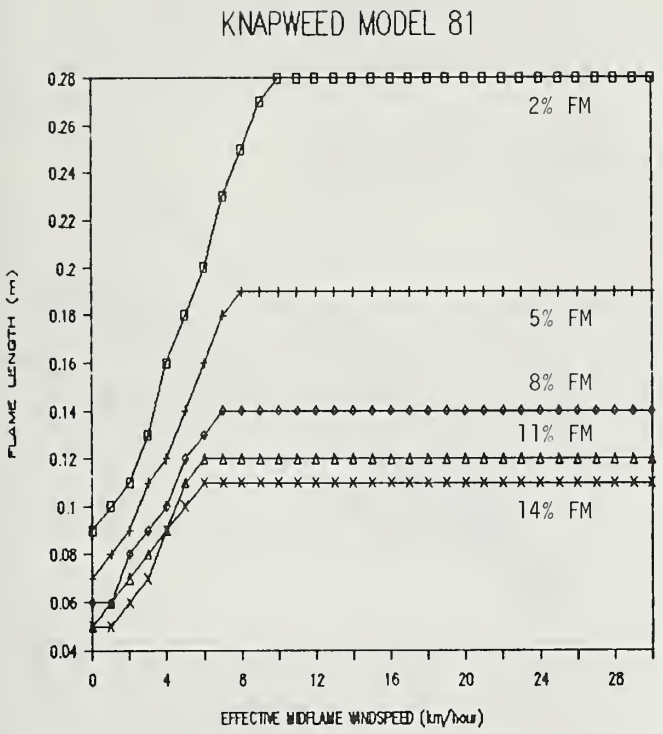

Figure 3--Predicted flame length (m) versus effective midflame windspeed (km/hour) for fuel model 81.

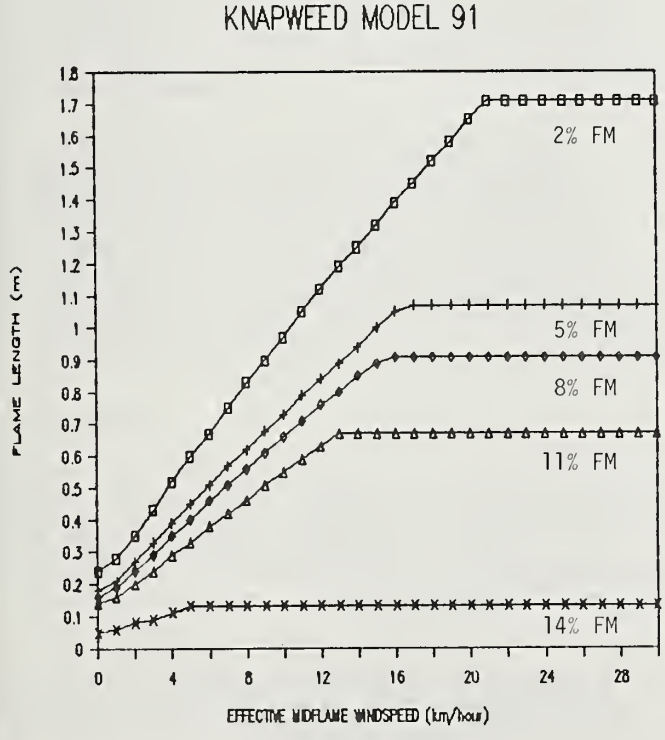

Figure 4--Predicted flame length (m) versus effective midflame windspeed (km/hour) for fuel model 91.

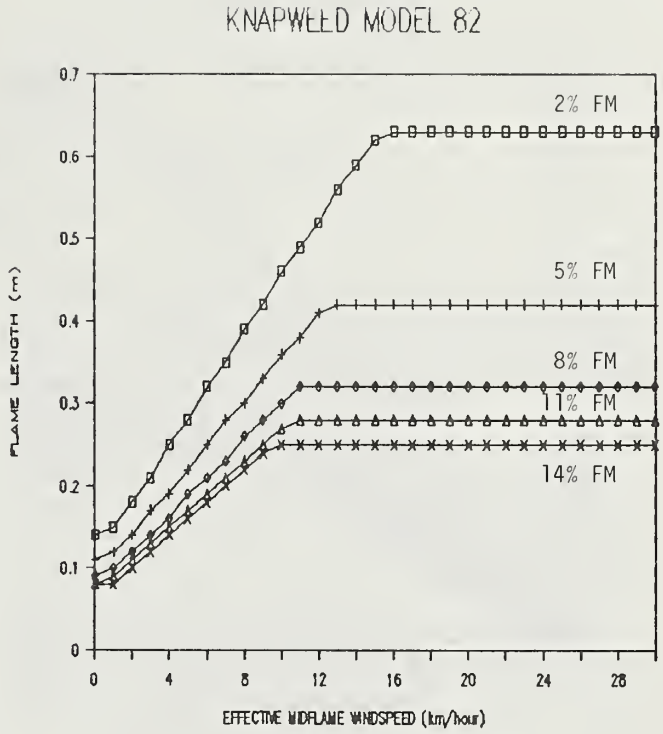

Figure 5--Predicted flame length (m) versus effective midflame windspeed (km/hour) for fuel model 82.

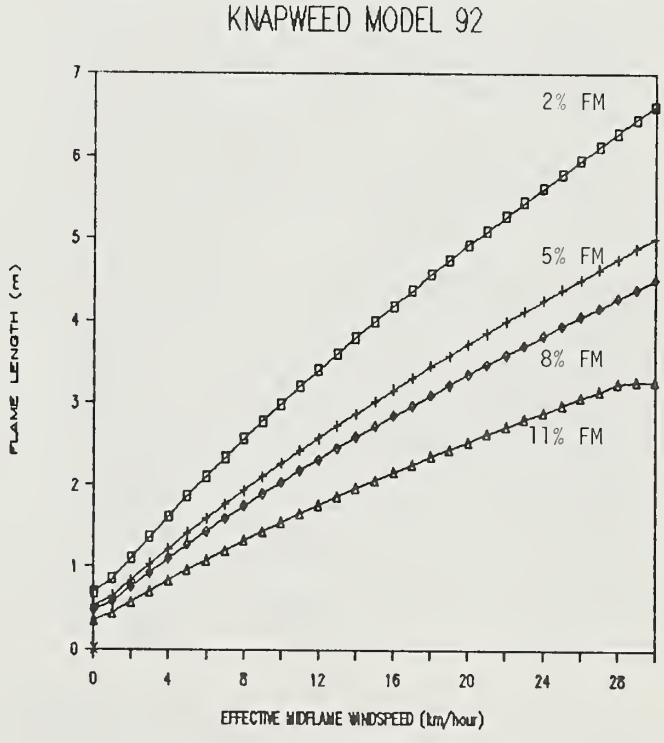

Figure 6--Predicted flame length (m) versus effective midflame windspeed (km/hour) for fuel model 92.

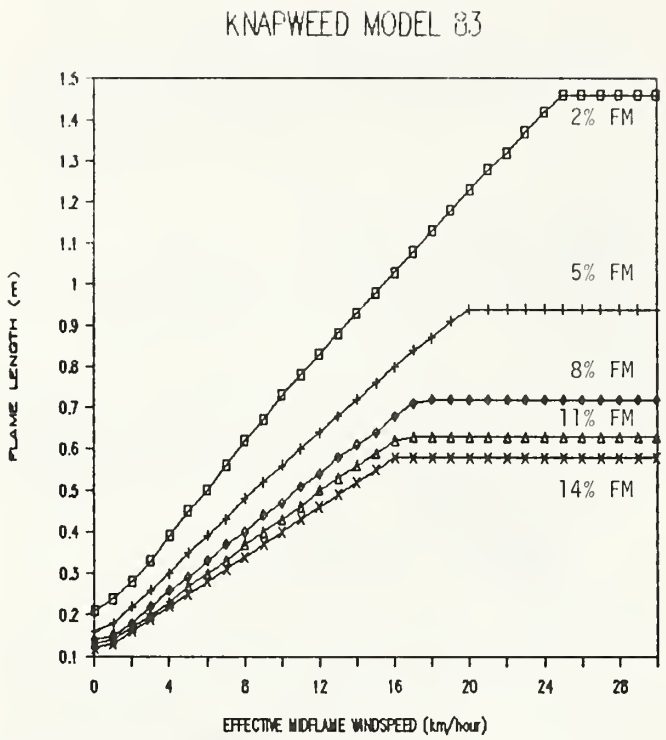

Figure 7--Predicted flame length (m) versus effective midflame windspeed (km/hour) for fuel model 83.

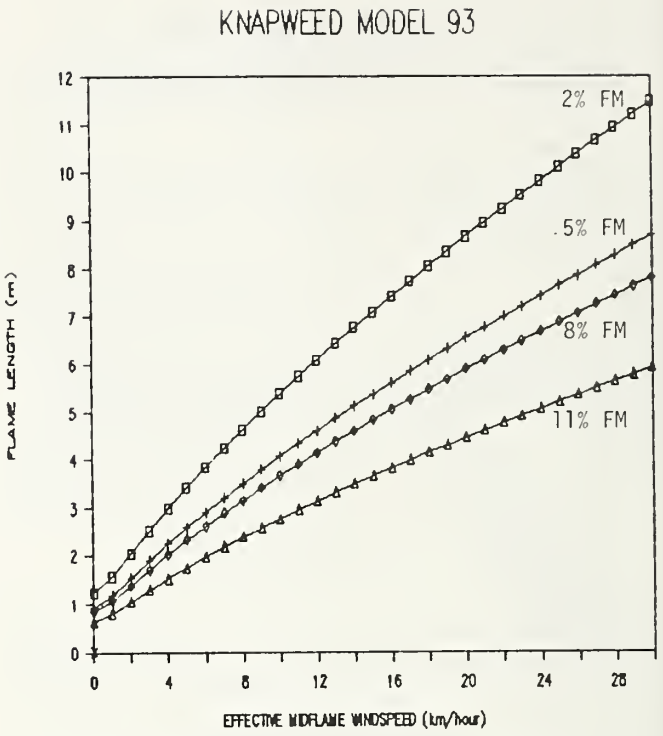

Figure 8--Predicted flame length (m) versus effective midflame windspeed (km/hour) for fuel model 93.

GREEK FOREST FIRES AND PROPERTY DAMAGE: A BRIEF HISTORY

Gavriil Xanthopoulos

ABSTRACT: Forest fires in Greece have historically burned 0.2% of the country's forest land each year. Property damages have been very small because of the use of non combustible materials in building construction. In recent years the percentage of area burned per year has nearly tripled and there have been significant losses of lives and property. This change is mainly the result of increased dead fuel availability and of the construction of houses within forest lands.

INTRODUCTION

Greece is a European country occupying an area of 130,875 km^2 in the southern Balkan Peninsula. Its population is 9,350,000 people. The climate is typically Mediterranean over most of the country, with warm-to-hot summers and mild winters.

Although more than half of the total land area is considered forest land, less than 20% is forested. The rest of the forest land is occupied by brushlands (maquis and Kermes Oak (Quercus coccifera) brushlands), open scrublands (phrygana) and grasslands. More than two-thirds of the forest belongs to the government.

Forest flammability is generally high. Most flammable types are the pine forests (Pinus halepensis, Pinus brutia) and the brushlands at the lower elevations, by the sea, in the middle and southern part of the country. Most of the population in recent years has concentrated in urban areas located near and expanding into these flammable forest types. Land value in these areas has become extremely high.

FOREST FIRES

Forest fires are very common in Greece every summer and early fall. Some of the worst wildfires happen in the low elevation pine forests which usually have a brush understory. They start as surface fires which frequently become fierce crown fires that defy all firefighting efforts. Crown fires most commonly remain coupled to the surface fire, although independently moving crown fires have also been observed (Kailidis 1981, Kailidis and Pantelis 1982). Surface fires in open brushlands are usually easier to control.

Long term statistics show that until 1976 about 0.2% of the tall forest and 0.2% of the grazing lands (brushlands and grasslands), burned every year (Kailidis 1981). In the last 15 years this percentage has nearly tripled. In the extremely dry year of 1985, 1.35% of the total forest land burned (Kailidis & others 1987). This is true in spite of the vast improvements in firefighting equipment in the last two decades. Only 5.3% of the total number of fires burn an area larger than 100 Ha, but in total they contribute about 72.5% of the area burned per year.

The reasons for the increase in number of fires and area burned are as follows (Kailidis & others 1987).

1. Decreased demand for fuel wood, following the urbanization of the people, has resulted in a 2-4 times increase of the available dead fuel on the ground during the last 30 years.
2. Less grazing has resulted in more fine fuels available to the fire.
3. A change of attitude of the people, who, contrary to the past, have become unwilling to help in firefighting, leaving it to the professionals.
4. A sharp increase of land value, especially close to cities and to sea shores where people build their summer houses. Arsonists use fire to destroy the forest because the Forest Law has strict provisions for building within a forest. Land ownership disputes between individuals and the state still exist.
5. An increase in number of visitors to the low elevation forests as more cars are available, and people spend more time in outdoor activities. In addition, the number of tourists visiting the country each year has increased sharply.
6. Political instability which has been shown to coincide with bad fire years.

PROPERTY DAMAGE

Literature on property damage resulting from wildfires, other than the burned forest itself, is scarce (Kailidis 1981). Three deaths and 300 people injured resulted from a 3,000 Ha wildfire in 1916 in a Pinus halepensis forest near Athens

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Paper presented at the Symposium and Workshop on Protecting People and Homes from Wildfire in the Interior West, Missoula, MT, October 6-8, 1987.

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belonging to the crown. The summer palace and other buildings were also destroyed in that fire. Since then and until a fierce crown fire in Athens (8/4/1981), only few small, temporary, mostly wooden, country buildings used by woodsmen and shepherds are known to have burned in forest fires. No more lives were lost until 1977.

As the forest fire situation became worse in Greece in recent years, more deaths have resulted from fires, mostly during fire suppression operations.

The 1981 fire in the northern suburbs of Athens, where houses had been built adjacent to or inside pine forests, resulted in significant property losses. In addition to tens of houses, cars, warehouses and other smaller buildings were destroyed. The houses burned between 2 and 3 pm under severe fire weather conditions (temperature 33-34°C, relative humidity 12%, and wind at 35 km/hr) which resulted in an independently moving crown fire (Kailidis 1981).

Severe forest fires in subsequent years have resulted in a few individual buildings adjacent to forests being burned, but not in the widespread fashion of the fire in Athens.

DISCUSSION

The vast majority of houses in Greece are traditionally built with non combustible materials (brick, concrete, clay tile roofs). Many villages have traditionally been built on steep slope terrain surrounded by forest or brushlands. In spite of this fact no major housing losses have resulted from historic wildfires in the past. This can be attributed both to the materials used in the construction of the houses and to the reduced amounts of dead fuels close to villages as a result of fuelwood collection and heavy grazing.

People nowdays choose to build their homes in the same ways using the same materials as in the past guided by tradition, availability of materials and common sense. There is no law requiring them to use these specific materials. In spite of this, even these houses can burn under extreme wildfire conditions. It should be noted though that the houses that burned on the large 1981 fire were between similar ones that did not burn although the fire reached their walls and roofs. It is speculated that windows may have been left open and that pine needles had accumulated on the roofs (Kailidis 1981). Another explanation may be that intense radiation from burning crowns may have ignited the curtains or other flammable materials inside these buildings.

The increase in area burned by a few large wildfires in recent years and the increase in life and property losses, in spite of the improved firefighting capabilities can be mainly attributed to the increase of available fuels. Regardless of materials and design, the presence of trees, shrubs, dead wood and needle litter close to a forest home, make it a candidate for burning.

One can speculate that the 1916 destruction of the palace and the loss of lives probably took place in the only forest in the country at the time, in which fuelwood collection was not permitted.

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Includes 25 invited papers and panel discussions, 6 workshop reports, and 15 poster papers that focus on the escalating problem of wildfire in wildland residential areas throughout the western United States and Canada.

KEYWORDS: fire, fire management, fire damage, hazard appraisal, fuel management, fire safety standards, fire codes, building codes, fire insurance, subdivisions, planning, residential development, "urban/rural interface", political constraints, cooperation

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The Intermountain Research Station provides scientific knowledge and technology to improve management, protection, and use of the forests and rangelands of the Intermountain West. Research is designed to meet the needs of National Forest managers, Federal and State agencies, industry, academic institutions, public and private organizations, and individuals. Results of research are made available through publications, symposia, workshops, training sessions, and personal contacts.

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